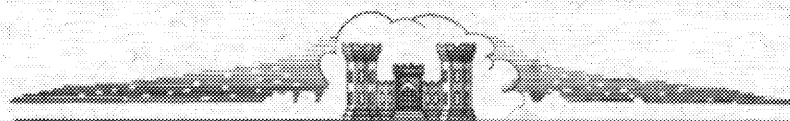
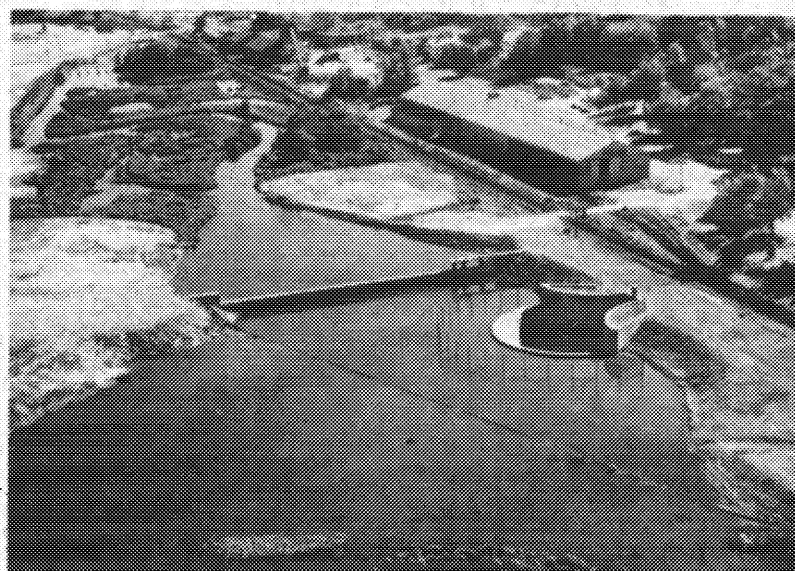


BLACKSTONE RIVER FLOOD CONTROL  
**OPERATION AND MAINTENANCE  
MANUAL**

FOR  
FLOOD PROTECTION WORKS

**WORCESTER DIVERSION**

**WORCESTER, MASSACHUSETTS**



U.S. ARMY ENGINEER DIVISION, NEW ENGLAND  
CORPS OF ENGINEERS WALTHAM, MASS.

**OCTOBER 1960**

OPERATION AND MAINTENANCE MANUAL

WORCESTER DIVERSION

BLACKSTONE RIVER BASIN  
AUBURN AND MILLBURY, MASSACHUSETTS

U. S. ARMY ENGINEER DIVISION  
NEW ENGLAND  
OFFICE OF THE DIVISION ENGINEER  
WALTHAM, MASSACHUSETTS

SEPTEMBER 1960

OPERATION AND MAINTENANCE MANUAL  
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# OPERATION AND MAINTENANCE MANUAL

## WORCESTER DIVERSION

### AUBURN AND MILLBURY, MASSACHUSETTS

#### FOREWORD

Effective control of floods by the Worcester Diversion is not assured solely by the construction of the project. To perform the functions for which it was designed, it must be carefully maintained during periods of normal river stages and properly operated during flood periods. This cannot be too highly stressed since large damages may be incurred through failure of a critical element in flood time, caused by deterioration or damage that could have been eliminated.

Necessary maintenance and proper operation require that responsible local persons have a thorough understanding of the project's components, recommended methods of maintenance and proper operating procedures.

It is the purpose of this manual to provide complete information so that all parties may fully understand their responsibilities in maintaining and operating the flood protection system in accordance with the regulations prescribed by the Secretary of the Army as amplified by this manual.

The general flood control Regulations for Maintenance and Operation of Flood Control Works quoted herein were approved by the Acting Secretary of War on 9 August 1944. Upon establishment of the Department of Defense, the improvement of rivers for flood control and other purposes became the responsibility of the Secretary of the Army. Reference herein to the Secretary of War and War Department shall therefore be construed to mean, respectively, the Secretary of the Army and the Department of the Army. Where reference is made to the District Engineer in the Regulations included in this manual, it shall be construed to mean the Division Engineer, U. S. Army Engineer Division, New England.

## A. GENERAL

### 1. PURPOSE

The purpose of this manual is to present detailed information to be used as a guide in complying with "Flood Control Regulations-Maintenance and Operation of Flood Control Works," as approved by the Acting Secretary of War on 9 August 1944, and published in this volume as Appendix A.

The City of Worcester, by executing assurances of local co-operation, has agreed to maintain and operate the completed Worcester Diversion project in accordance with these regulations.

The regulations are intended to cover all local protection projects constructed by the Department of the Army throughout the United States, are general in nature, and obviously cannot give detailed instructions for maintenance and operation of a specific project. The details as set forth in this manual supplement the Regulations to insure maximum protection against floods for which the project was designed. Failure to maintain and operate the project as required by the Regulations and as detailed herein can result in severe property losses, loss of life, and the waste of funds invested by citizens in a valuable flood control system.

### 2. PROJECT AUTHORIZATION

The Worcester Diversion was authorized by the Flood Control Act of 22 December 1944 (Public Law 534, 78th Congress) in accordance with recommendations of the Chief of Engineers set forth in House Document No. 624, 78th Congress, 2d Session.

### 3. PROJECT LOCATION

The Worcester Diversion is located in the towns of Auburn and Millbury, Worcester County, Massachusetts. Its intake is located in Auburn, approximately 1-1/4 miles south of Leesville Dam on the easterly edge of Leesville Pond, an artificial pond on Kettle Brook. From the intake, the diversion passes southeasterly in a tunnel through Pakachoag Hill, thence in an open channel following the general alignment of Hull Brook to the Blackstone River. The downstream portion of the return channel, which terminates about 3,500 feet south of the Worcester city limits, is in Millbury.

#### 4. DESCRIPTION OF PROJECT

The function of the project is to permit flood flows originating in the Kettle Brook drainage area to bypass the city of Worcester by conducting them through a diversion tunnel and thence to the Blackstone River. Major project components necessary for this purpose consist of (a) a control dam across Leesville Pond; (b) an ungated overflow structure consisting of an intake weir and transition; (c) a concrete lined tunnel, partly in earth and partly in rock, through Pakachoag Hill; (d) a stilling basin; and (e) a return channel cut partly in rock and partly in earth leading to the Blackstone River. In addition, highway bridges have been constructed over the return channel at U.S. Route 20, Pinrock Rd., Mass. Turnpike and Greenwood Street. A railroad bridge has also been constructed over the return channel near its junction with the Blackstone River.

Two 5'-0"x5'-0" gated outlets in the control dam spillway are designed to pass normal Leesville Pond flow without creating any diversion. Under moderate flow conditions, the restricted outlet openings will cause a sufficient backwater level to overtop the intake weir. Closure of the control dam gates will effect complete diversion of all flows up to the capacity of the tunnel.

#### 5. EFFECTIVENESS OF PROTECTION

The diversion intake weir, with crest at El 487.0, operating under a surcharge of 5 feet, will pass a flow of 6,000 c.f.s., which is the capacity of the diversion tunnel. This discharge is approximately 1-1/2 times the Kettle Brook flood of record of 3,970 c.f.s. on 19 August 1955. For flows greater than 6,000 c.f.s., water will flow over the control dam spillway weir which is at El. 492.0, but the diversion will continue to handle its design capacity. The embankment section of the control dam has a top elevation of 498.0 which is one foot above the estimated water level if an additional 6,000 c.f.s. is discharged over the control dam spillway.

#### 6. CONSTRUCTION HISTORY

Construction of the Worcester Diversion was started in July 1957 and completed in January 1960. The work was carried out by the Kero-Curly Construction co., Inc. The railroad bridge construction was handled by the New York, New Haven and Hartford RR under separate agreement.



Work carried out by local interests with non-Federal funds consisted of the Massachusetts Turnpike Bridge by the Massachusetts Turnpike Authority; and the construction of three highway bridges, the relocation of the Tennessee Gas Transmission Company pipeline; the relocation of the Socony-Mobil Oil Company pipeline and the relocation of utility pole lines by the Massachusetts Department of Public Works.

## 7. PLANS

Plans pertinent to the operation and maintenance of the project are included for reference as Appendix D in this volume. Full size tracings of "as-built" construction drawings have been provided the City of Worcester.

## 8. LOCAL COOPERATION

The authorizing legislation for the Worcester Diversion Project (1944 Flood Control Act) required that responsible local agencies give assurance satisfactory to the Secretary of War that they would:

(a) Provide, without cost to the United States, all lands, easements, and rights-of-way necessary for the construction of the project;

"(b) Hold and save the United States free from damages due to the construction works, and:

"(c) Maintain and operate all works after completion in accordance with regulations prescribed by the Secretary of War."

The assurances of the City of Worcester and the Commonwealth of Massachusetts are contained in Appendix B of this volume. This manual is to assist the City in fulfilling the requirements of "(c)" above in their responsibilities for maintaining and operating the project.

## 9. GENERAL RULES AND REGULATIONS

Paragraph 208.10(a) of the regulations prescribed by the Secretary of War gives general rules for the maintenance and operation of structures and facilities constructed by the United States for local flood protection. Applicable portions are quoted below to avoid the necessity for cross reference and are further defined by remarks under each quotation.

"(1) The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for such periods as may be necessary to obtain the maximum benefits."

These requirements cannot be overstressed, and the City authorities must make adequate provisions for funds, personnel, equipment, and materials to allow for the proper maintenance and operation of the flood protective works.

"(2) The State, political subdivision thereof, or other responsible local agency, which furnished assurance that it will maintain and operate flood control works in accordance with regulations prescribed by the Secretary of War, as required by law, shall appoint a permanent committee consisting of or headed by an official hereinafter called the 'Superintendent', who shall be responsible for the development and maintenance of, and directly in charge of, an organization responsible for the efficient operation and maintenance of all of the structures and facilities during flood periods and for continuous inspection and maintenance of the project works during the periods of low water, all without cost to the United States."

The committee should be composed of competent members, preferably men experienced in engineering or construction work of a nature similar to the flood protection works. The committee must be given broad authority to carry out its responsibilities. The name, address, and office and home telephone numbers of the Superintendent, and any changes thereof, shall be promptly furnished the Division Engineer.

"(3) A reserve supply of materials needed during a flood emergency shall be kept on hand at all times."

Three men should be available to meet any ordinary emergency that may occur during flood periods. Borrow pits for embankment gravel and rock materials should be secured and sources of additional supplies of materials, tools, and equipment should be well established in order that these articles can be obtained quickly in case of an emergency.

"(4) No encroachment or trespass which will adversely affect the efficient operation or maintenance of the project works shall be permitted upon the rights-of-way for the protective facilities."

The disposal of rubbish, erection of fences, or barriers, or any form of trespassing on the project shall be prohibited.

"(5) No improvement shall be passed over, under, or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the War Department or his authorized representatives that such improvement, excavation, construction, or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice. Advice regarding the effect of proposed improvements or alterations on the functioning of the project and information concerning methods of construction acceptable under standard engineering practice shall be obtained from the District Engineer or, if otherwise obtained, shall be submitted for his approval. Drawings or prints showing such improvements or alterations as finally constructed shall be furnished the District Engineer after completion of the work."

Any contemplated improvements or alterations as outlined above must be submitted to the Corps of Engineers, Waltham, Massachusetts, and the approval of the Division Engineer obtained prior to the City authorizing the work. All requests for approval shall be in writing and complete drawings in duplicate, one set of which shall be in reproducible form, must be submitted along with a full description of the work intended. The City shall furnish the Division Engineer as-built drawings, in duplicate, of the completed work.

"(6) It shall be the duty of the Superintendent to submit a semi-annual report to the District Engineer covering inspection, maintenance, and operation of the protective works."

See Paragraph 12 of this Manual for instructions on submitting reports.

"(7) The District Engineer or his authorized representatives shall have access at all times to all portions of the protective works."

The Division Engineer or his representatives will make periodic inspections of the protective works to determine if the project is being properly maintained and operated by the City.

"(8) Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made."

The City should maintain the facilities and keep them in good repair and not wait for the Division Engineer to call such matters to its attention. Upon request, the Division Office will advise the City how to make any major repairs to the facilities.

"(9) Appropriate measures shall be taken by local authorities to insure that the activities of all local organizations operating public or private facilities connected with the protective works are coordinated with those of the Superintendent's organization during flood periods."

"(10) The War Department will furnish local interests with an Operation and Maintenance Manual for each completed project, or separate useful part thereof, to assist them in carrying out their obligations under these regulations."

The flood control committee should familiarize itself with the contents of this manual. The City authorities are encouraged to call on the Division Office of the Corps of Engineers for any additional advice or instructions required by them in carrying out the City's obligations for maintaining and operating the flood protection facilities.

## 10. MAINTENANCE

a. The work "maintenance" as used in this manual applies to the upkeep, repair and care of the work constructed by the United States and turned over to the City of Worcester. If the work is neglected, there will be deterioration and possible failure in flood time when there is dire need of dependable protection.

b. Satisfactory and dependable operation depends on constant maintenance. The organization that performs maintenance must be familiar with various parts of the system and will be in a position to use them effectively in time of stress.

c. Maintenance includes regular inspection of the entire system. The purpose of an inspection is to detect any deterioration or faulty operation that indicates a need for repair or replacement. This does not mean a casual automobile trip to places easily accessible but actually walking over every part of the system.

d. In addition to inspection, dam equipment and gates require testing at stated intervals to discover the difficulties that may develop or the part that will not work when it should.

e. Each of the major features of the project is discussed separately. Particular emphasis is placed on those points which, based on experience with special project features, require special attention.

## 11. OPERATION

a. Operation in this manual refers to the actual use of the various features of the protection works during flood periods. It is intended that the procedure outlined herein will be sufficient to insure optimum protection from floods. Advice relative to operation may be obtained at any time from the Engineering Division of the New England Division Office.

b. When abnormal river flows and stages are expected, it is important that the Superintendent make immediate decisions and take prompt action and that he have the authority to carry out his decisions.

c. To insure correct operation it is essential that at least three persons be familiar with all phases of the flood protection works, know when to initiate gate operation at the dam, know just what supplies and transport are on hand, and know what men and tools can be mobilized for the patrolling and repair work.

d. Arrangements should be made with the United States Weather Bureau Office, Bradley Field, Windsor Locks, Connecticut (telephone number NATIONAL 3-5590), to keep the City informed on flood predictions.

The U. S. Weather Bureau at Bradley Field is the official agency for collecting precipitation and runoff data and the preparation of flood forecasts and is responsible for issuance of flood warnings in the Blackstone River Basin.

## 12. INSPECTION AND REPORTS

The regulations prescribed by the Secretary of the Army call for semi-annual reports to be submitted by the Superintendent to the Division Engineer, covering inspection, maintenance and operation. Inspection of the flood protective facilities shall be made immediately prior to flood seasons, immediately following floods, and otherwise at intervals not exceeding 90 days as required by the regulations. Floods can occur and have occurred in any season of the year (March 1927, November 1927, July and September 1938, October 1954 and August 1955).

To assist the Superintendent in making his inspections and reports, sample forms have been prepared and are included in Appendix C. The Superintendent shall have additional copies printed for use in submitting his reports.

The semi-annual reports shall be submitted in triplicate to the Division Engineer each February and August. The reports will be submitted in letter form with copies of the inspection forms covering the inspections made during the period of the report. The reports shall cover the following points:

- a. A description of the maintenance work performed in the preceding six months.
- b. The number and classification of men working on maintenance, regularly and intermittently.
- c. Description of any work performed by contract on the repair or improvement of the project.
- d. Description of use or operation of the system during the period being reported.
- e. Suggestions relative to public cooperation and comments concerning public sentiment on the protection obtained are considered pertinent and desirable data for inclusion in the report, but such data are not required.

In addition to the maintenance reports discussed above, monthly reports of operations will be submitted to the Division Engineer. The purpose of the monthly reports is to maintain an up-to-date record of project operations, so that prescribed regulation procedures may be analyzed and modified, where necessary, as actual regulation experience indicates. These reports should include gage readings, gate settings, and other pertinent information.

## B. CONTROL DAM

### 13. DESCRIPTION

The control dam is located approximately  $1\frac{1}{4}$  miles upstream from the outlet of the pond at Leesville Dam. It consists of a concrete spillway 180 feet long and a non-overflow earth dam 350 feet long with rock slopes.

The concrete spillway section has a crest elevation of 492.0 feet m.s.l. Two hand-operated 5' x 5' sluice gates are installed in the spillway adjacent to the right (easterly) bank. A portable gasoline engine is also provided to facilitate operation of the gates. The gates are operated from a concrete platform directly over the spillway weir which extends from the right bank to the limits of the gated section. An ungated opening, 18" in diameter-invert elevation 483.0, has been provided through the concrete weir adjacent to the second sluice gate from the right bank. This opening assures a minimum flow of approximately 12 c.f.s. into the lower pool. A rockfill toe, 15' wide by 2'-6" in depth, has been placed at the downstream end of the concrete apron of the weir, extending its entire length. A log boom extends from the left concrete abutment of the spillway to an anchor located on the right bank approximately 400 feet upstream of the control dam. This unit is located to intercept floating material and debris so that it may be drifted out of the channel for removal and disposal.

The non-overflow structure is constructed of earth with an impervious core. Side slopes are protected with rockfill 2'-0" thick. A rock toe 10 feet wide and 2'-6" deep has been installed at the downstream slope adjoining the rock toe of the spillway apron and continuing to the left bank of the pond. A permanent easement has been obtained from the westerly end of the earth dam and follows upstream along the 500-foot contour to high ground. Within the limits of this strip there shall be no excavation, construction or alteration of any kind permitted that would allow high water to bypass the control dam or would otherwise be detrimental to the functioning of the flood control structures.

Vehicular access to the control dam and intake structure area is provided on both sides of Leesville Pond as shown on the drawings.

#### 14. MAINTENANCE

Periodic inspection shall be made of this structure by the Superintendent and appropriate maintenance measures taken to insure that facilities which function as a part of it will operate properly. Regulations, modified as applicable to this structure, shall be followed to be certain that:

a. Gates, gasoline operator and operating mechanisms are in good working order so that proper closure can be made promptly when necessary. Measures shall be taken to provide for cleaning equipment, repainting as necessary, lubricating all machinery, storing emergency supplies of fuel and emergency lighting equipment. Gates shall be trial operated and only skilled mechanics shall be employed on tests and repairs.

b. Log boom anchors, chains, cable and logs are structurally sound, repainted as necessary, and that intercepted debris has been removed and disposed of.

c. Concrete structures do not evidence cracking, chipping, settlement, deformation, or undermining by seepage which will reduce the capacity of the approach and discharge channels.

e. Erosion is not occurring adjacent to the structure which might endanger its water-tightness or stability.

f. No unusual settlement, sloughing or material loss of grade or embankment cross section has taken place.

g. No caving has occurred on either the upstream or downstream side of the dam or either side of abutments which might affect the stability of the structures.

h. No riprap has been displaced or removed.

i. Access roads to the project are properly maintained.

j. Encroachments are not being made on the structure right-of-way which might endanger the structure or hinder its proper functioning in times of emergency.

k. Inspections are made immediately prior to the beginning of each flood season; immediately following each major high water period, and otherwise at intervals not exceeding 90 days, and at such intermediate times as may be necessary to insure the best possible care of the structure. Immediate steps shall be taken to correct dangerous conditions disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent.



## 15. OPERATION

Personnel selected for responsible control of gate regulation at the control dam should be thoroughly familiar with equipment being utilized. Emergency conditions may develop during floods which require immediate judgment and adoption of unique regulating procedures and emergency measures. Close liaison will be maintained by representatives of the Division Engineer to insure that operating personnel of the City of Worcester are thoroughly trained, qualified to operate the equipment, and to perfect the regulation procedures under actual operating conditions.

The control dam gate operating procedure is as follows:

a. Normal operation. The two 5'-0" x 5'-0" gates will remain wide open to permit the passage of normal flows through Leesville Pond.

b. Index point. The staff gage downstream of Curtis Pond on the Webster Street bridge near the Worcester County Electric Plant is the index point for flood control operation.

c. Flood operation during rising stage. To insure full benefit from the project, premature closure of the control dam gates is preferable to tardy operation. Consequently, one gate may be closed whenever a severe storm has occurred, heavy spring runoff is taking place, or high rates of flow are anticipated on tributaries of the Middle and Blackstone Rivers.

If not already lowered, close one gate when a rising river stage reaches elevation 466.0 on the index gage.

Close the second gate whenever warranted by local conditions, but in any event as soon as the river stage reaches 468.0 on the index gage.

d. Flood operation during falling stage. During the recession of a flood, open one gate when the stage falls to elevation 468.0, and open the second gate when the stage falls to elevation 466.0.

e. Notification to others. The Worcester County Electric Company should be advised of all gate operations. Their plant requires a minimum flow of about 18 c.f.s. for cooling purposes which, during a flood, will be supplied by local runoff and the 18-inch ungated outlet in the control dam. Under some conditions, however, it may be advisable to open the second gate about 6 inches to supplement this flow.

f. Water stage records. An hourly record of stages at the index point should be maintained during all flood operation periods. An hourly record of Leesville Pond stages at the diversion intake structure gage should also be maintained during flood operation periods.

g. Effect of flood operation. Under normal flow conditions, Leesville Pond elevations will be in the vicinity of 1 to 1.5 feet below the crest of the tunnel intake structure and all flow will pass the open control dam gates. Under increasing flow conditions, water levels will rise in Leesville Pond, resulting in an automatic but partial diversion of water through the tunnel. Operation of the control dam gates will diminish flows downstream of the control dam in Worcester, and correspondingly increase the amount of water which is diverted.

h. Major flood conditions. Under extremely severe flood conditions it is possible that water levels will overtop the crest of the control dam spillway weir which is at an elevation 5 feet above the crest of the tunnel intake structure. Control dam gates should remain closed. Under these circumstances complete diversion of flow is impossible; however, the maximum diversion capacity of the tunnel will be effective throughout the flood. At such times a continuous patrol of the control dam shall be maintained to locate possible sand boils, scouring or unusual wetness of the downstream embankment slope, to ascertain both control dam abutments are secure and to be certain that:

- (1) There are no indications of slides or sloughs developing;
- (2) Wave wash or scouring action is not occurring;
- (3) No low reaches along the banks exist which will permit water to bypass the control dam and erode abutments;
- (4) No other conditions exist which might endanger the structure.

If any indication of scouring or erosion due to overflow is observed, soundings should be taken to determine its magnitude and progress. Sandbagging or dumped rock will generally afford the most practical means of combating this condition. Sandbags should be placed in the erosions in as effective a manner as possible, carrying the protection well above the action of the water. Sandbags used for this purpose require only about one-half cubic foot of material and should be sewed or tied. The aim is to obtain the maximum coverage with only sufficient weight to hold the sack in place.

## C. DIVERSION STRUCTURES

### 16. GENERAL DESCRIPTION

The complete diversion structure consists of an intake, concrete lined tunnel, and a stilling basin at the tunnel outlet.

The intake structure is a semi-circular weir with a crest elevation of 487.0. It also includes a debris barrier, consisting of 21 piles placed concentrically, and located 30 feet away from the structure spaced on approximately 12-foot centers. This structure forms the entrance to the 16-foot diameter tunnel, 4,205 feet long, through Pakachoag Hill. The elevation of the tunnel invert and intake transition is 451.8. The section of tunnel from the intake is built in earth for a distance of approximately 440 feet before the rock formation is encountered. The remaining section of the tunnel is constructed in rock to the outlet portal. The rate of grade for the tunnel invert is .01065. At the outlet portal the elevation is 407.0. The entire tunnel is circular in shape and lined with concrete. A stilling basin constructed of concrete in rock extends from the outlet portal 120 feet downstream with a concrete baffle installed in the rock channel 100 feet downstream from the end of the stilling basin.

### 17. MAINTENANCE

Periodic inspection shall be made of this structure and appropriate maintenance measures taken as necessary to assure proper functioning. The following excerpts from the regulations have been modified to be applicable to this structure. Be certain that:

a. The debris barrier is structurally sound, repainted as necessary and that intercepted debris has been removed and disposed of.

b. Approach and egress channels are sufficiently clear of obstructions, debris, silt, shoals and fallen rock to permit the passage of design flows. The approach area to the intake structure shall be maintained below elevation 484 at all times and silt and other deposits which encroach on the intake structure's approach depth shall be removed to original design grades.

c. Concrete structures do not evidence cracking, chipping, settlement or deformation which might affect their stability.

d. No riprap has been displaced or removed and riprapped banks are in good condition.

e. Inspections are made immediately prior to the beginning of each flood season; immediately following each major highwater period, and otherwise at intervals not to exceed 90 days. Immediate steps shall be taken to remedy any adverse condition disclosed by such inspections. The Superintendent shall provide for periodic repair and cleaning of the intake weir, tunnel and stilling basin as may be required.

#### 18. OPERATION

The intake and outlet area of the structure shall be patrolled during periods of high water. Appropriate measures shall be taken to prevent the formation of jams of ice or debris. Large objects which become ledged against the bank shall be removed. The structure shall be thoroughly inspected immediately following each high water period. As soon as practicable thereafter, all snags and other debris shall be removed and all damage to banks and riprap and other structures repaired.

## D. RETURN CHANNEL

### 19. DESCRIPTION

The return channel extending from the end of the stilling basin at Station 47/20 to the Blackstone River generally follows the bed of Hull Brook and is divided into three main reaches. The first reach from Station 47/20 to about Station 55/00 is entirely in rock, with a bottom width of 40 feet, side slopes of 4 vertical on 1 horizontal and a channel bottom slope of .0025.

The second reach extends from the end of the channel in rock to the Massachusetts Turnpike crossing and is generally in earth with a bottom width of 35 feet and side slopes of 1 vertical on 2-1/2 horizontal. The earth slopes are protected with 2'-6" of rockfill. The bottom channel slope is .000964 to meet the invert of the existing Turnpike crossing.

The third reach from the break in bottom grade at the Turnpike crossing extends to Station 154/20 with a bottom width of 50 feet and side slopes of 1 vertical on 2-1/2 horizontal. It is covered with 2'-6" of rockfill. The bottom channel slope is .000589. In order to pass normal flood flows under the NYNH & H Railroad and to flare the outlet into the Blackstone River, the bottom width is increased from 50 feet to 80 feet by a transition between Stations 154/20 and 156/20. The span of the railroad bridge is 80 feet.

### 20. MAINTENANCE

Periodic inspection shall be made of the channel and appropriate maintenance measures taken as necessary to assure proper functioning. The following excerpts from the regulations have been modified to be applicable to this structure. Be certain that:

- a. The channel is clear of debris, weeds, trees, and wild growth.
- b. The channel is not being restricted by deposit of waste materials, debris, shoals, fallen rock, building of unauthorized structures or other encroachments.
- c. Banks are not being damaged by rain, overland drainage or wave wash and that no sloughing of the banks has occurred;
- d. Riprap sections are in good condition;

Inspections shall be made prior to the beginning of each flood season; and otherwise at intervals not to exceed 90 days. Immediate steps shall be taken to remedy any adverse conditions disclosed by such inspections.

## 21. OPERATION

Both banks of the channel shall be patrolled during periods of high water, and measures shall be taken to protect those reaches being attacked by the current or by wave wash. Appropriate measures shall be taken to prevent the formation of jams of ice or debris. Large objects which become lodged against the bank shall be removed.

Under major flood conditions it is anticipated that water levels will overtop the low channel banks and inundate areas adjacent to the lower half of the return channel's length. This condition, however, is attributed to backwater from high stages on the Blackstone River and not as a result of the diversions action. Under similar flood circumstances, these areas would be inundated whether or not the diversion project was in operation.

The channel shall be thoroughly inspected immediately following each major highwater period. As soon as practical thereafter, all snags and other debris shall be removed and all damage to banks, riprap and other flood structures repaired.

## E. BRIDGES

### 22. DESCRIPTION

There are 4 bridges and a 3-barrel box culvert crossing the return channel, at various locations, between the tunnel outlet and the Blackstone River. Three of the bridges and the box culvert are highway structures and one bridge is a single-track railroad bridge. The highway structures were designed and constructed by non-Federal agencies after thorough coordination with project requirements. The railroad bridge was designed and constructed under railroad supervision.

### 23. MAINTENANCE

The bridges should be maintained so that they do not become obstructions during periods of flood discharge. Modifications of the structures which could encroach on clearances should be coordinated with the Division Engineer.

### 24. OPERATION

During a flood, observations for debris should be made at all bridges. Equipment should be available within reasonable time and distance to assist in debris removal where necessary. Special attention should be given to the box culvert structure under the Mass. Turnpike, and the railroad bridge at the Blackstone River. The two dividing sections of the box culvert (Mass. Turnpike) are in the channel and could cause a jam in the event an appreciable amount of floating materials and debris are being carried in a flood discharge. The railroad bridge has the least head room of all the bridges in the project. Frequent check on this structure, in the early stages of a flood, is desirable to make sure that debris and floating material are not causing a jam at this location.

## F. OPERATIONS PLAN

### 25. PROJECT OPERATIONS

A considered and practiced plan of project operation should be in readiness at all times. Severe floods can occur at any time of the year. However, there is usually a limited period of warning in which to mobilize men and equipment for serious flood conditions.

### 26. COOPERATION

Representatives of the Division Engineer stand ready to assist the City in the operation of the project. This in no way lessens the responsibility of the City in operation of the project.



APPENDIX A

Regulations Prescribed By The  
Secretary Of The Army

## TITLE 33—NAVIGATION AND NAVIGABLE WATERS

### Chapter II—Corps of Engineers, War Department

#### PART 208—FLOOD CONTROL REGULATIONS MAINTENANCE AND OPERATION OF FLOOD CONTROL WORKS

Pursuant to the provisions of section 3 of the Act of Congress approved June 22, 1938, as amended and supplemented (49 Stat. 1571; 50 Stat. 877; and 55 Stat. 638; 33 U. S. C. 701c; 701c-1), the following regulations are hereby prescribed to govern the maintenance and operation of flood control works:

§ 208.10 *Local flood protection works; maintenance and operation of structures and facilities*—(a) *General.* (1) The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for such periods as may be necessary to obtain the maximum benefits.

(2) The State, political subdivision thereof, or other responsible local agency, which furnished assurance that it will maintain and operate flood control works in accordance with regulations prescribed by the Secretary of War, as required by law, shall appoint a permanent committee consisting of or headed by an official hereinafter called the "Superintendent," who shall be responsible for the development and maintenance of, and directly in charge of, an organization responsible for the efficient operation and maintenance of all of the structures and facilities during flood periods and for continuous inspection and maintenance of the project works during periods of low water, all without cost to the United States.

(3) A reserve supply of materials needed during a flood emergency shall be kept on hand at all times.

(4) No encroachment or trespass which will adversely affect the efficient operation or maintenance of the project works shall be permitted upon the right-of-way for the protective facilities.

(5) No improvement shall be passed over, under, or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the War Department or his authorized representative that such improvement, excavation, construction, or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice. Advice regarding the effect of proposed improvements or alterations on the functioning of the project and information concerning methods of construction acceptable under standard engineering practice shall be obtained from the District Engineer or, if otherwise obtained, shall be submitted for his approval. Drawings or prints showing such improvements or alterations as finally constructed shall be furnished the District Engineer after completion of the work.

(6) It shall be the duty of the superintendent to submit a semiannual report to the District Engineer covering inspection, maintenance, and operation of the protective works.

(7) The District Engineer or his authorized representatives shall have access at all times to all portions of the protective works.

(8) Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made.

(9) Appropriate measures shall be taken by local authorities to insure that the activities of all local organizations operating public or private facilities connected with the protective works are coordinated with those of the Superintendent's organization during flood periods.

(10) The War Department will furnish local interests with an Operation and Maintenance Manual for each completed project, or separate useful part thereof, to assist them in carrying out their obligations under these regulations.

(b) *Levees*—(1) *Maintenance.* The Superintendent shall provide at all times such maintenance as may be required to insure serviceability of the structures in time of flood. Measures shall be taken to promote the growth of sod, exterminate burrowing animals, and to provide for routine mowing of the grass and weeds, removal of wild growth and drift deposits, and repair of damage caused by erosion or other forces. Where practicable, measures shall be taken to retard bank erosion by planting of willows or other suitable growth on areas riverward of the levees. Periodic inspections shall be made by the Superintendent to insure that the above maintenance measures are being effectively carried out and, further, to be certain that:

(i) No unusual settlement, sloughing, or material loss of grade or levee cross section has taken place;

(ii) No caving has occurred on either the land side or the river side of the levee which might affect the stability of the levee section;

(iii) No seepage, saturated areas, or sand boils are occurring;

(iv) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged;

(v) Drains through the levees and gates on said drains are in good working condition;

(vi) No revetment work or riprap has been displaced, washed out, or removed;

(vii) No action is being taken; such as burning grass and weeds during inappropriate seasons, which will retard or destroy the growth of sod;

(viii) Access roads to and on the levee are being properly maintained;

(ix) Cattle guards and gates are in good condition;

(x) Crown of levee is shaped so as to drain readily, and roadway thereon, if any, is well shaped and maintained;

(xi) There is no unauthorized grazing or vehicular traffic on the levees;

(xii) Encroachments are not being made on the levee right-of-way which might endanger the structure or hinder its proper and efficient functioning during times of emergency.

Such inspections shall be made immediately prior to the beginning of the flood season; immediately following each major high water period, and otherwise at intervals not exceeding 90 days; and such intermediate times as may be necessary to insure the best possible care of

the levee. Immediate steps will be taken to correct dangerous conditions disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent.

(2) *Operation.* During flood periods the levee shall be patrolled continuously to locate possible sand boils or unusual wetness of the landward slope and to be certain that:

(i) There are no indications of slides or sloughs developing;

(ii) Wave wash or scouring action is not occurring;

(iii) No low reaches of levee exist which may be overtopped;

(iv) No other conditions exist which might endanger the structure.

Appropriate advance measures will be taken to insure the availability of adequate labor and materials to meet all contingencies. Immediate steps will be taken to control any condition which endangers the levee and to repair the damaged section.

(c) *Flood walls*—(1) *Maintenance.* Periodic inspections shall be made by the Superintendent to be certain that:

(i) No seepage, saturated areas, or sand boils are occurring;

(ii) No undue settlement has occurred which affects the stability of the wall or its water tightness;

(iii) No trees exist, the roots of which might extend under the wall and offer accelerated seepage paths;

(iv) The concrete has not undergone cracking, chipping, or breaking to an extent which might affect the stability of the wall or its water tightness;

(v) There are no encroachments upon the right-of-way which might endanger the structure or hinder its functioning in time of flood;

(vi) Care is being exercised to prevent accumulation of trash and debris adjacent to walls, and to insure that no fires are being built near them;

(vii) No bank caving conditions exist riverward of the wall which might endanger its stability;

(viii) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged.

Such inspections shall be made immediately prior to the beginning of the flood season, immediately following each major high water period, and otherwise at intervals not exceeding 90 days. Measures to eliminate encroachments and effect repairs found necessary by such inspections shall be undertaken immediately. All repairs shall be accomplished by methods acceptable in standard engineering practice.

(2) *Operation.* Continuous patrol of the wall shall be maintained during flood periods to locate possible leakage at monolith joints or seepage underneath the wall. Floating plant or boats will not be allowed to lie against or tie up to the wall. Should it become necessary during a flood emergency to pass anchor cables over the wall, adequate measures shall be taken to protect the concrete and construction joints. Immediate steps shall be taken to correct any condition which endangers the stability of the wall.

(d) *Drainage structures*—(1) *Maintenance.* Adequate measures shall be taken to insure that inlet and outlet channels are kept open and that trash, drift, or debris is not allowed to accumulate near drainage structures. Flap gates and manually operated gates and valves on

drainage structures shall be examined, oiled, and trial operated at least once every 90 days. Where drainage structures are provided with stop log or other emergency closures, the condition of the equipment and its housing shall be inspected regularly and a trial installation of the emergency closure shall be made at least once each year. Periodic inspections shall be made by the Superintendent to be certain that:

(i) Pipes, gates, operating mechanism, riprap, and headwalls are in good condition;

(ii) Inlet and outlet channels are open;

(iii) Care is being exercised to prevent the accumulation of trash and debris near the structures and that no fires are being built near bituminous coated pipes;

(iv) Erosion is not occurring adjacent to the structure which might endanger its water tightness or stability.

Immediate steps will be taken to repair damage, replace missing or broken parts, or remedy adverse conditions disclosed by such inspections.

(2) *Operation.* Whenever high water conditions impend, all gates will be inspected a short time before water reaches the invert of the pipe and any object which might prevent closure of the gate shall be removed. Automatic gates shall be closely observed until it has been ascertained that they are securely closed. Manually operated gates and valves shall be closed as necessary to prevent inflow of flood water. All drainage structures in levees shall be inspected frequently during floods to ascertain whether seepage is taking place along the lines of their contact with the embankment. Immediate steps shall be taken to correct any adverse condition.

(e) *Closure structures—(1) Maintenance.* Closure structures for traffic openings shall be inspected by the superintendent every 90 days to be certain that:

(i) No parts are missing;

(ii) Metal parts are adequately covered with paint;

(iii) All movable parts are in satisfactory working order,

(iv) Proper closure can be made promptly when necessary;

(v) Sufficient materials are on hand for the erection of sand bag closures and that the location of such materials will be readily accessible in times of emergency.

Tools and parts shall not be removed for other use. Trial erections of one or more closure structures shall be made once each year, alternating the structures chosen so that each gate will be erected at least once in each 3-year period. Trial erection of all closure structures shall be made whenever a change is made in key operating personnel. Where railroad operation makes trial erection of a closure structure infeasible, rigorous inspection and drill of operating personnel may be substituted therefor. Trial erection of sand bag closures is not required. Closure materials will be carefully checked prior to and following flood periods, and damaged or missing parts shall be repaired or replaced immediately.

(2) *Operation.* Erection of each movable closure shall be started in sufficient time to permit completion before flood waters reach the top of the structure sill. Information regarding the proper method of erecting each individual closure structure, together with an estimate of the time required by an experienced crew to complete its erection will be given

in the Operation and Maintenance Manual which will be furnished local interests upon completion of the project. Closure structures will be inspected frequently during flood periods to ascertain that no undue leakage is occurring and that drains provided to care for ordinary leakage are functioning properly. Boats or floating plant shall not be allowed to tie up to closure structures or to discharge passengers or cargo over them.

(f) *Pumping plants—(1) Maintenance.* Pumping plants shall be inspected by the Superintendent at intervals not to exceed 30 days during flood seasons and 90 days during off-flood seasons to insure that all equipment is in order for instant use. At regular intervals, proper measures shall be taken to provide for cleaning plant, buildings, and equipment, repainting as necessary, and lubricating all machinery. Adequate supplies of lubricants for all types of machines, fuel for gasoline or diesel powered equipment, and flash lights or lanterns for emergency lighting shall be kept on hand at all times. Telephone service shall be maintained at pumping plants. All equipment, including switch gear, transformers, motors, pumps, valves, and gates shall be trial operated and checked at least once every 90 days. Megger tests of all insulation shall be made whenever wiring has been subjected to undue dampness and otherwise at intervals not to exceed one year. A record shall be kept showing the results of such tests. Wiring disclosed to be in an unsatisfactory condition by such tests shall be brought to a satisfactory condition or shall be promptly replaced. Diesel and gasoline engines shall be started at such intervals and allowed to run for such length of time as may be necessary to insure their serviceability in times of emergency. Only skilled electricians and mechanics shall be employed on tests and repairs. Operating personnel for the plant shall be present during tests. Any equipment removed from the station for repair or replacement shall be returned or replaced as soon as practicable and shall be trial operated after reinstallation. Repairs requiring removal of equipment from the plant shall be made during off-flood seasons insofar as practicable.

(2) *Operation.* Competent operators shall be on duty at pumping plants whenever it appears that necessity for pump operation is imminent. The operator shall thoroughly inspect, trial operate, and place in readiness all plant equipment. The operator shall be familiar with the equipment manufacturers' instructions and drawings and with the "Operating Instructions" for each station. The equipment shall be operated in accordance with the above-mentioned "Operating Instructions" and care shall be exercised that proper lubrication is being supplied all equipment, and that no overheating, undue vibration or noise is occurring. Immediately upon final recession of flood waters, the pumping station shall be thoroughly cleaned, pump house sumps flushed, and equipment thoroughly inspected, oiled and greased. A record or log of pumping plant operation shall be kept for each station, a copy of which shall be furnished the District Engineer following each flood.

(g) *Channels and floodways—(1) Maintenance.* Periodic inspections of improved channels and floodways shall be made by the Superintendent to be certain that:

(i) The channel or floodway is clear of debris, weeds, and wild growth;

(ii) The channel or floodway is not being restricted by the depositing of waste materials, building of unauthorized structures or other encroachments;

(iii) The capacity of the channel or floodway is not being reduced by the formation of shoals;

(iv) Banks are not being damaged by rain or wave wash, and that no sloughing of banks has occurred;

(v) Riprap sections and deflection dikes and walls are in good condition;

(vi) Approach and egress channels adjacent to the improved channel or floodway are sufficiently clear of obstructions and debris to permit proper functioning of the project works.

Such inspections shall be made prior to the beginning of the flood season and otherwise at intervals not to exceed 90 days. Immediate steps will be taken to remedy any adverse conditions disclosed by such inspections. Measures will be taken by the Superintendent to promote the growth of grass on bank slopes and earth deflection dikes. The Superintendent shall provide for periodic repair and cleaning of debris basins, check dams, and related structures as may be necessary.

(2) *Operation.* Both banks of the channel shall be patrolled during periods of high water, and measures shall be taken to protect those reaches being attacked by the current or by wave wash. Appropriate measures shall be taken to prevent the formation of jams of ice or debris. Large objects which become lodged against the bank shall be removed. The improved channel or floodway shall be thoroughly inspected immediately following each major high water period. As soon as practicable thereafter, all snags and other debris shall be removed and all damage to banks, riprap, deflection dikes and walls, drainage outlets, or other flood control structures repaired.

(h) *Miscellaneous facilities—(1) Maintenance.* Miscellaneous structures and facilities constructed as a part of the protective works and other structures and facilities which function as a part of, or affect the efficient functioning of the protective works, shall be periodically inspected by the Superintendent and appropriate maintenance measures taken. Damaged or unserviceable parts shall be repaired or replaced without delay. Areas used for ponding in connection with pumping plants or for temporary storage of interior run-off during flood periods shall not be allowed to become filled with silt, debris, or dumped material. The Superintendent shall take proper steps to prevent restriction of bridge openings and, where practicable, shall provide for temporary raising during floods of bridges which restrict channel capacities during high flows.

(2) *Operation.* Miscellaneous facilities shall be operated to prevent or reduce flooding during periods of high water. Those facilities constructed as a part of the protective works shall not be used for purposes other than flood protection without approval of the District Engineer unless designed therefor. (49 Stat. 1571, 50 Stat. 877; and 55 Stat. 638; 33 U.S.C. 701c; 701c-1) (Regs. 9 August 1944, CE SPEWF)

[SEAL]

J. A. ULIO,  
Major General,  
The Adjutant General.

[F. R. Doc. 44-12285; Filed, August 16, 1944;  
9:44 a.m.]

APPENDIX B

Assurances Of Local Cooperation

1. Assurance Of The Commonwealth  
Of Massachusetts
2. Modification To Assurance Of The  
Commonwealth Of Massachusetts
3. Assurance Of The City Of Worcester

ASSURANCE  
OF THE  
COMMONWEALTH OF MASSACHUSETTS

WHEREAS, the project on Blackstone River for local flood protection at Worcester, Massachusetts, known as the Worcester Diversion Project, is authorized by the Flood Control Act approved 22 December 1944 (Public Law 534, 78th Congress) as amended by Flood Control Act of 1946 approved July 24, 1946 (60 Stat. 641), substantially in accordance with recommendations in House Document No. 624, 78th Congress, 2nd Session; and

WHEREAS, the Worcester Diversion Project provides for a Diversion Conduit and Channel from Kettle Brook to the Blackstone River in accordance with plans prepared by the New England Division, Corps of Engineers, United States Army; and

WHEREAS, the said project is to be prosecuted under the direction of the Secretary of The Army and the supervision of the Chief of Engineers, Corps of Engineers, United States Army; and

WHEREAS, local interests desire the prosecution of this project; and

WHEREAS, this project is authorized subject to the condition that local interests give Assurances, satisfactory to the Secretary of the Army, that they will meet the conditions of local cooperation imposed by said authorizing Act as amended; and

WHEREAS, Section 7 of said Flood Control Act of 1946 relieves local interests of responsibility for construction of Railroad Bridges and approach thereto; and

WHEREAS, Chapter 15 of Acts and Resolves of the Commonwealth of Massachusetts, approved January 26, 1956, entitled: "An Act Providing For Co-operation With The Federal Government In Its Flood Control Project In The Kettle and Blackstone Rivers, Known as The Worcester Diversion", authorizes the Department of Public Works of the Commonwealth of Massachusetts to execute and convey to the United States Assurances of the Commonwealth in form

satisfactory to the Secretary of The Army, that the Department will perform all acts required to be performed by local interests in connection with the construction of the works by the United States, and further authorizes the City of Worcester to maintain and operate, in accordance with Regulations prescribed by the Secretary of The Army, such flood control works when completed as are within the Towns of Auburn and Millbury and within the City of Worcester.

NOW, THEREFORE, to comply with the requirements of the said Flood Control Act approved 22 December 1944 as amended by said Flood Control Act of 1946, the Commonwealth of Massachusetts, acting by and through its Department of Public Works and under authority of said Chapter 15 of the Acts and Resolves of Commonwealth of Massachusetts approved January 26, 1956, hereby Assures the United States of America that it will:

- a.) Furnish without cost to the United States the necessary lands, easements and rights-of-way required for this project;
- b.) Hold and save the United States of America free from damages due to the construction works;
- c.) Construct two highway bridges across the Worcester Diversion Channel;
- d.) Relocate three telephone service poles;
- e.) Lower a petroleum pipe line;
- f.) Care for an eight-inch water main under the present bridge on Greenwood Street;
- g.) Perform all acts required to be performed by local interests in connection with the construction of the works by the United States.

IN WITNESS WHEREOF, the Commonwealth of Massachusetts has executed the within Assurance this seventeenth day of February, 1956.

APPROVED BY:

Christian A. Herter  
Christian A. Herter, Governor (Acting)

COMMONWEALTH OF MASSACHUSETTS

BY John A. Walsh  
Commissioner of Public Works

APPROVED BY GOVERNOR'S COUNCIL

Charles J. Gabriel  
Bruce Crane  
Guy A. Wells  
James R. Allen

James J. Tracy  
Associate Commissioner  
Robert W. Hoyle  
Augustus J. ...

ACCEPTANCE

March 16 1956.

The within Assurance is hereby accepted for and on behalf of the  
United States of America.

BY Robert J. Fleming, Jr.  
ROBERT J. FLEMING, JR.  
Brigadier General USA  
Division Engineer

MODIFICATION NO. 1

TO: ASSURANCE OF THE COMMONWEALTH OF MASSACHUSETTS DATED FEBRUARY 17, 1956.  
AND EXECUTED IN CONNECTION WITH THE LOCAL FLOOD PROTECTION PROJECT AT  
WORCESTER, MASSACHUSETTS.

WHEREAS, on February 17, 1956, the Commonwealth of Massachusetts executed and delivered to the United States of America its assurance required under the provisions of the Flood Control Act approved 22 December 1944 (Public Law 534, 78th Congress) as amended by Flood Control Act of 1946 approved July 24, 1946 (60 Stat. 641); and

WHEREAS, Chapter 15 of the Acts and Resolves of the Commonwealth of Massachusetts approved January 26, 1956, providing for cooperation with the Federal Government has been amended by Chapter 725 of the Acts and Resolves of the Commonwealth of Massachusetts dated 5 October 1956; and

WHEREAS, it has been determined a gas line will require relocation within the project area; and

WHEREAS, the construction of an additional highway bridge will be required.

NOW, THEREFORE, it is understood and agreed by the Commonwealth of Massachusetts, acting through its Department of Public Works and under authority of said Chapter 15 of the Acts and Resolves of the Commonwealth of Massachusetts approved January 26, 1956, and as amended by Chapter 725 of said Acts and Resolves dated 5 October 1956, that the Assurance of the Commonwealth of Massachusetts dated February 17, 1956 be amended as follows:

1. On Page 1 of the Assurance the seventh paragraph which begins with the word "Whereas, Chapter 15, etc.," following the words "Worcester Diversion," add the following: "as amended by Chapter 725 of the Acts and Resolves of the Commonwealth of Massachusetts dated 5 October 1956."

2. In the first paragraph contained on Page 2 of said Assurance which begins with the words, "Now, Therefore" following the words, "January 26, 1956,"



add "as amended by Chapter 725 of the Acts and Resolves of the Commonwealth of Massachusetts, dated 5 October 1956."

3. Delete paragraph c. and insert and substitute therefor the following: "c.) Construct three highway bridges across the Worcester Diversion Channel and perform all acts including construction of certain by-passes required to be performed by local interest in connection with the construction of the project for the Government."

4. Delete paragraph e. and insert and substitute therefor the following: "e.) Lower petroleum pipe line and relocate gas lines located within the project area."

IN WITNESS WHEREOF, the Commonwealth of Massachusetts has executed the within Modification to its Assurance dated February 17, 1956, this 20<sup>th</sup> day of June 1957.

APPROVED BY:

*John F. Kennedy*  
Governor

COMMONWEALTH OF MASSACHUSETTS

By *John A. Shivers*  
Commissioner of Public Works

APPROVED BY GOVERNOR'S COUNCIL

*Christian A. Thakur*  
*Joseph J. Conboy*  
*Joseph R. Conboy*  
*Michael J. Farrell*

*Charles J. Gabriel*  
*August L. Luman*  
*Raymond F. Sullivan*  
*Patrick J. McDonough*

ACCEPTANCE

22 July 1957

The within Modification is hereby accepted for and on behalf of the United States of America.

By *Alden K. Sibley*  
ALDEN K. SIBLEY  
Brigadier General USA  
Division Engineer

Approved as to form

*Joseph H. Elcock Jr.*  
Assistant Attorney General

ASSURANCE  
OF THE  
CITY OF WORCESTER, MASSACHUSETTS

WHEREAS, the project on Blackstone River for local flood protection at Worcester, Massachusetts, known as the Worcester Diversion Project, is authorized by the Flood Control Act approved 22 December 1944 (Public Law 534, 78th Congress) as amended by Flood Control Act of 1946 approved July 24, 1946 (60 Stat. 641), substantially in accordance with recommendations in House Document No. 624, 78th Congress, 2nd Session; and

WHEREAS, the Worcester Diversion Project provides for a Diversion Conduit and Channel from Kettle Brook to the Blackstone River in accordance with plans prepared by the New England Division, Corps of Engineers, United States Army; and

WHEREAS, the said project is to be prosecuted under the direction of the Secretary of The Army and the supervision of the Chief of Engineers, Corps of Engineers, United States Army; and

WHEREAS, local interests desire the prosecution of this project; and

WHEREAS, this project is authorized subject to the condition that local interests give Assurances, satisfactory to the Secretary of The Army, that they will meet the conditions of local cooperation imposed by said authorizing Act as amended; and

WHEREAS, Section 3 of said Flood Control Act of 1946 relieves local interests of responsibility for construction of Railroad Bridges and approaches thereto; and

WHEREAS, Chapter 15 of Acts and Resolves of the Commonwealth of Massachusetts, approved January 26, 1956, entitled: "An Act Providing For Co-operation With The Federal Government In Its Flood Control Project In The Middle and Blackstone Rivers, Known as The Worcester Diversion", authorizes the Department of Public Works of the Commonwealth of Massachusetts to execute and convey to the United States Assurances of the Commonwealth in form

satisfactory to the Secretary of The Army, that the Department will perform all acts required to be performed by local interests in connection with the construction of the works by the United States, and further authorizes the City of Worcester to maintain and operate, in accordance with Regulations prescribed by the Secretary of The Army, such flood control works when completed as are within the Towns of Auburn and Milbury and within the City of Worcester.

NOW, THEREFORE, to comply with the requirements of the said Flood Control Act approved 22 December 1944 as amended by said Flood Control Act of 1946, the City of Worcester in accordance with its Ordinance dated February 14, 1956, copy of which is attached hereto and made a part hereof, and under authority of said Chapter 15 of the Acts and Resolves of the Commonwealth of Massachusetts approved January 26, 1956, hereby assures the United States of America that it will maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of The Army.

IN WITNESS WHEREOF, the City of Worcester has caused its Municipal Seal to be affixed hereto and these presents to be signed on its behalf by Francis J. McGrath, its City Manager, thereunto duly authorized this 24th day of February, 1956.

Signed and Sealed  
In Presence of:

/s/ Harry J. Meleski

CITY OF WORCESTER

BY /s/ Francis J. McGrath  
Francis J. McGrath, City Manager

ACCEPTANCE

16th March, 1956

The within Assurance is hereby accepted for and on behalf of the United States of America.

BY /s/ Robert J. Fleming, Jr.  
ROBERT J. FLEMING, JR.  
Brigadier General, USA  
Division Engineer

APPENDIX C

INSPECTION REPORT FORMS

FLOOD PROTECTIVE WORKS  
WORCESTER DIVERSION  
INSPECTION REPORT

FOR PERIOD \_\_\_\_\_

1. Control Dam

- a. Date inspected by Superintendent \_\_\_\_\_
- b. Condition of slopes & top (non-overflow section) \_\_\_\_\_
- c. Condition of spillway \_\_\_\_\_
- d. Any evidence of surface deterioration? \_\_\_\_\_
- e. Any development of cracks? \_\_\_\_\_
- f. Any evidence of movement or settlement? \_\_\_\_\_
- g. Any cracking or spalling of concrete at joints? \_\_\_\_\_
- h. Gates \_\_\_\_\_
  - (a) When first operated \_\_\_\_\_
  - (b) General condition \_\_\_\_\_
  - (c) Leaks \_\_\_\_\_
  - (d) Lubrication \_\_\_\_\_
  - (e) Painting \_\_\_\_\_
- i. Condition of log boom, cable, chains and anchorages. \_\_\_\_\_
- j. Condition of security fence \_\_\_\_\_
- k. Describe deficiencies, location, and corrective measures planned. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2. Diversion Structure

- a. Date inspected by Superintendent \_\_\_\_\_
- b. General condition of walls-intake-stilling basin \_\_\_\_\_
- c. Any evidence of surface deterioration? \_\_\_\_\_
- d. Any development of cracks? \_\_\_\_\_
- e. Any evidence of movement or settlement? \_\_\_\_\_
- f. Condition of debris barrier \_\_\_\_\_
- g. Describe deficiencies, location, and corrective measures planned. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

3. Return Channel

- a. Date inspected by Superintendent. \_\_\_\_\_
- b. General condition of channel \_\_\_\_\_
- c. Has capacity of channel been reduced  
due to growth of vegetation, shoaling,  
rock falls, or other encroachments? \_\_\_\_\_
- d. General condition of stone slope  
protection. \_\_\_\_\_
- e. Has there been any removal of stone? \_\_\_\_\_
- f. Describe deficiencies, location, and  
corrective measures planned. \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4. General

- a. Have all deficiencies noted in previous  
Inspection Report been corrected? \_\_\_\_\_
- b. Has any high water been experienced  
since last Inspection Report? \_\_\_\_\_  
If so, describe briefly, including  
dates, height of water and effect on  
protective works. \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Submitted:

(Signed) \_\_\_\_\_  
Superintendent

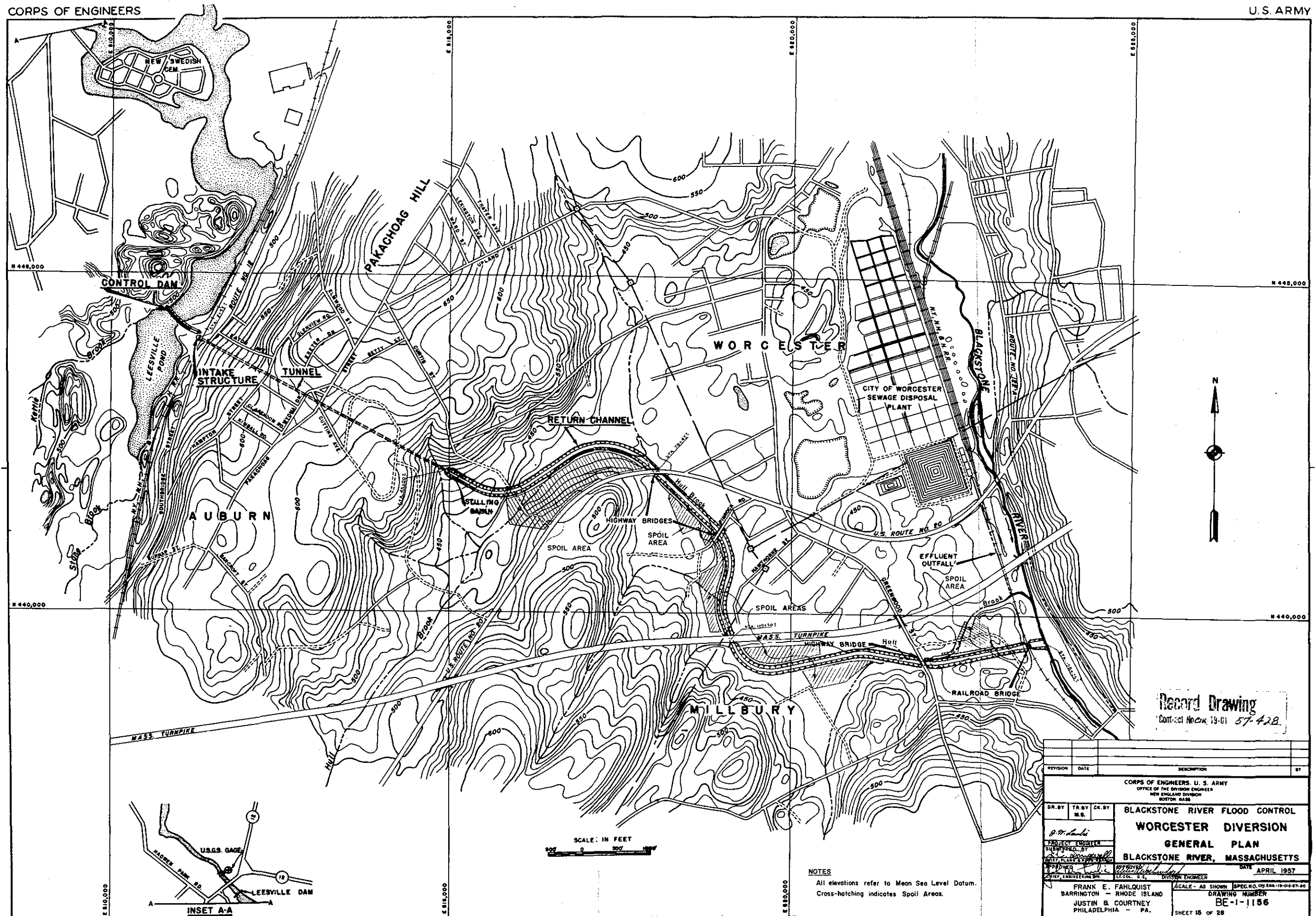
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(Date)

APPENDIX D

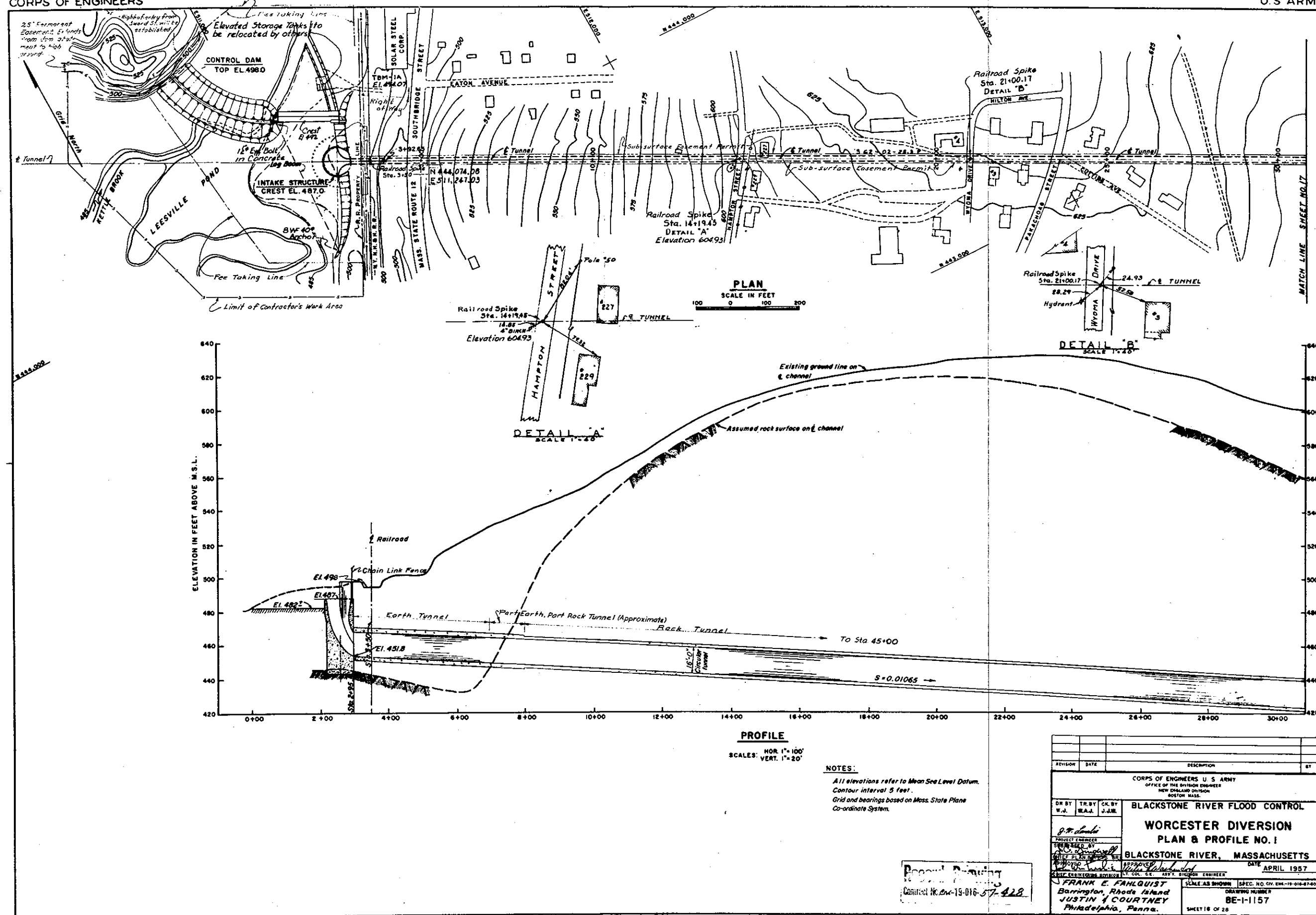
PLANS

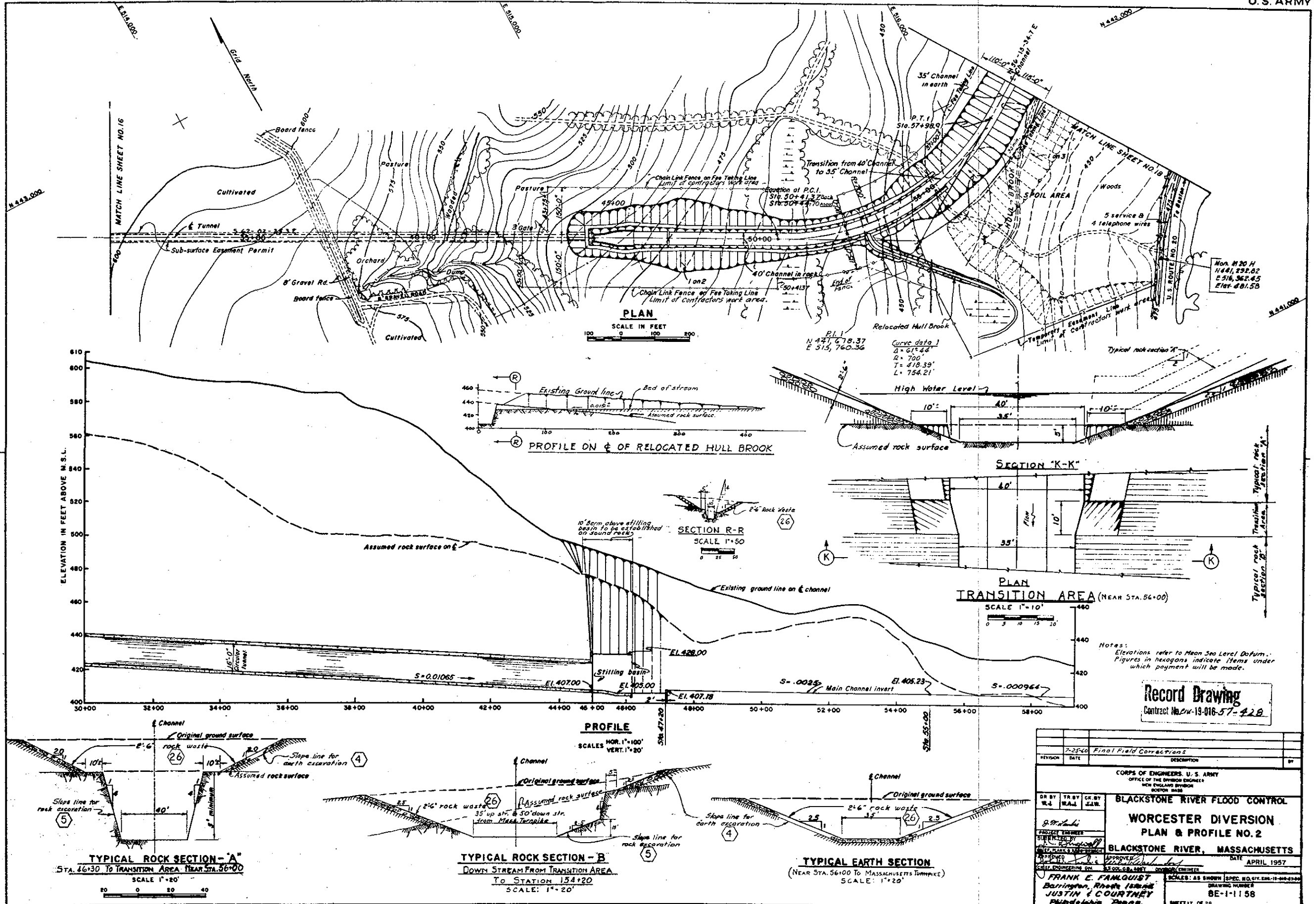
LIST OF PLATES

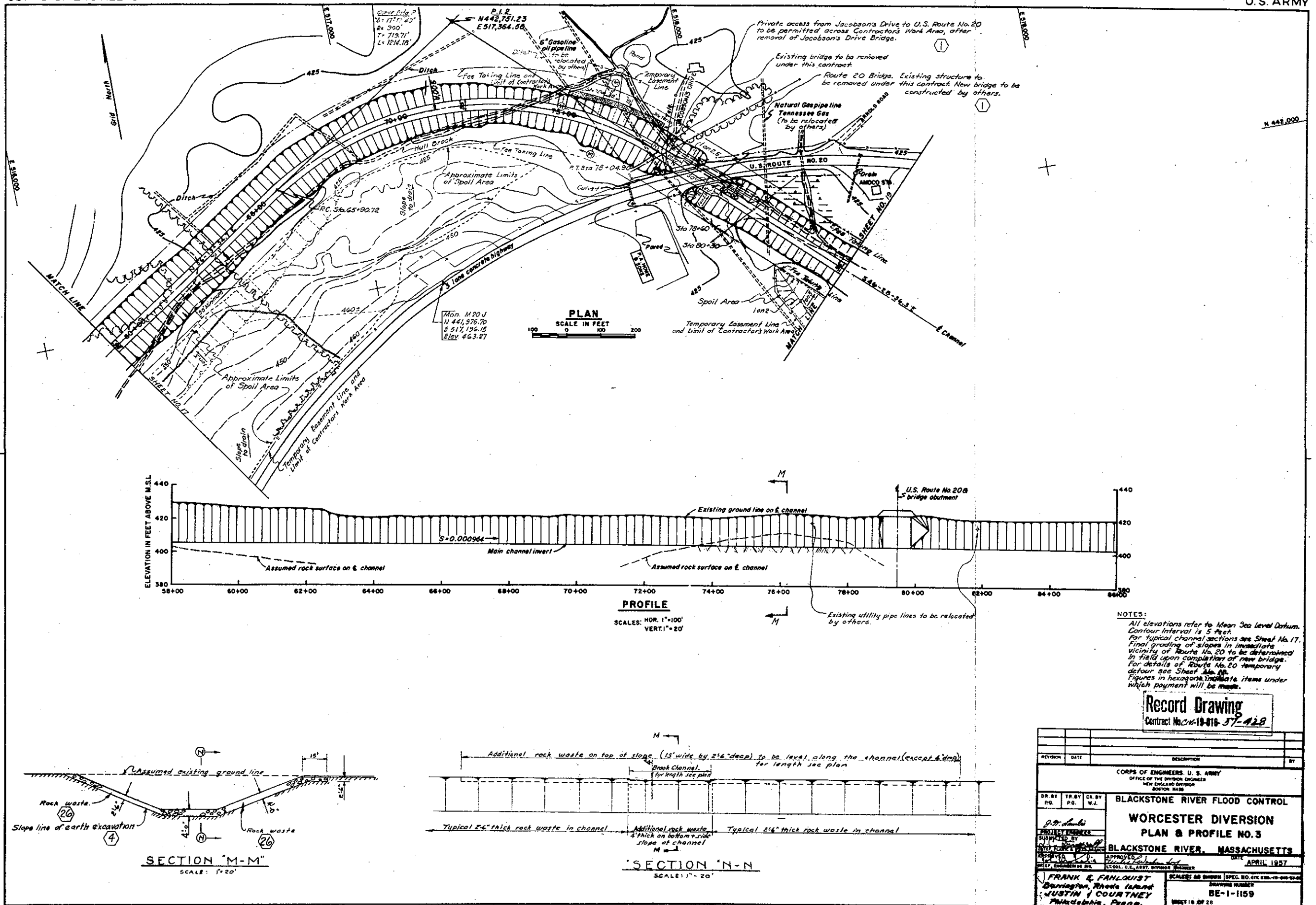
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D-2	Plan & Profile No. 1
D-3	Plan & Profile No. 2
D-4	Plan & Profile No. 3
D-5	Plan & Profile No. 4
D-6	Plan & Profile No. 5
D-7	Plan & Profile No. 6
D-8	Intake Area - General Plan and Sections
D-9	Tunnel
D-10	Intake Structure
D-11	Stilling Basin
D-12	Concrete Gravity Control Dam - Details
D-13	Hydrographs No. 1
D-14	Hydrographs No. 2

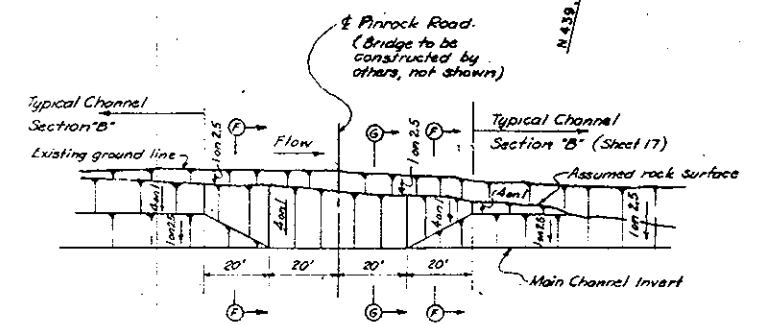
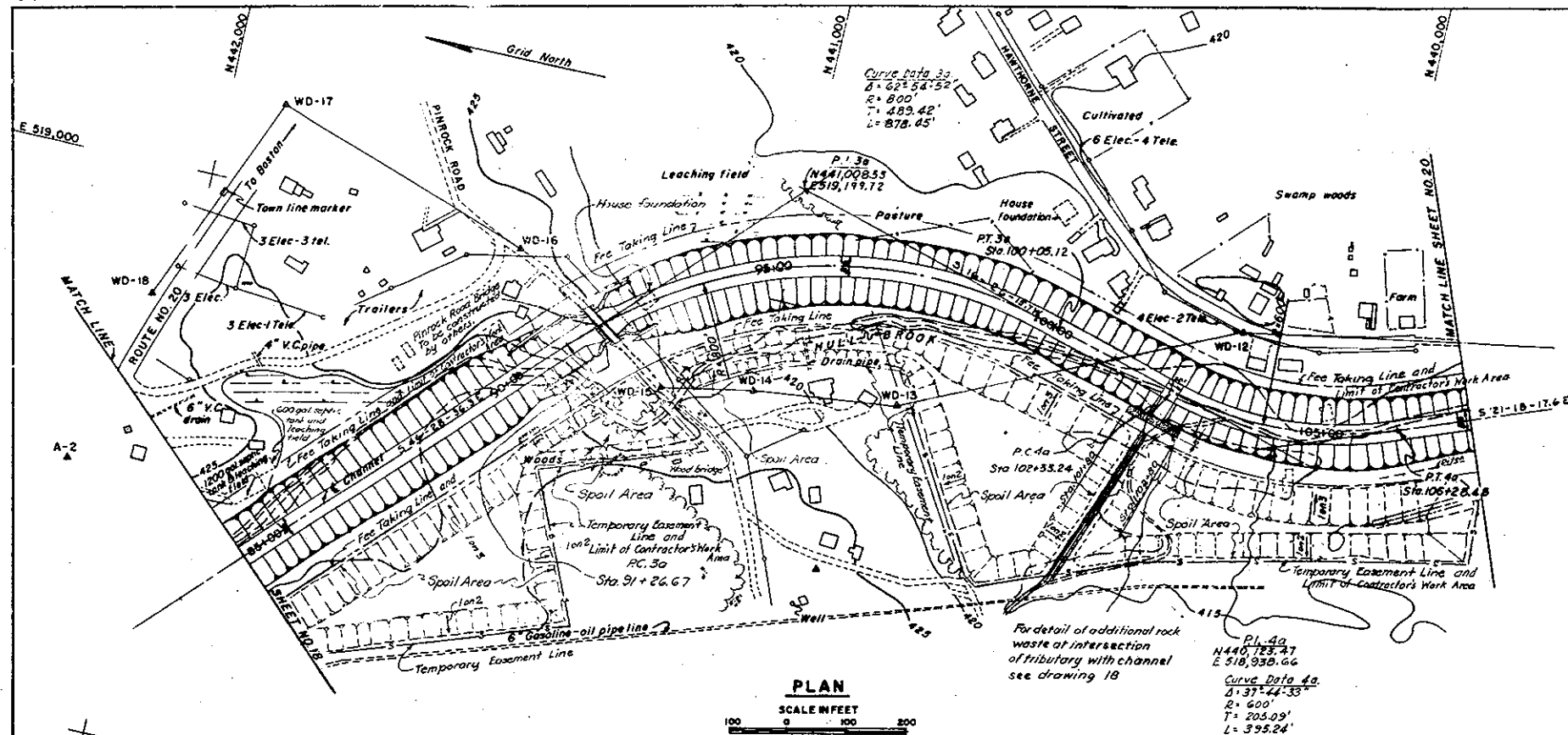






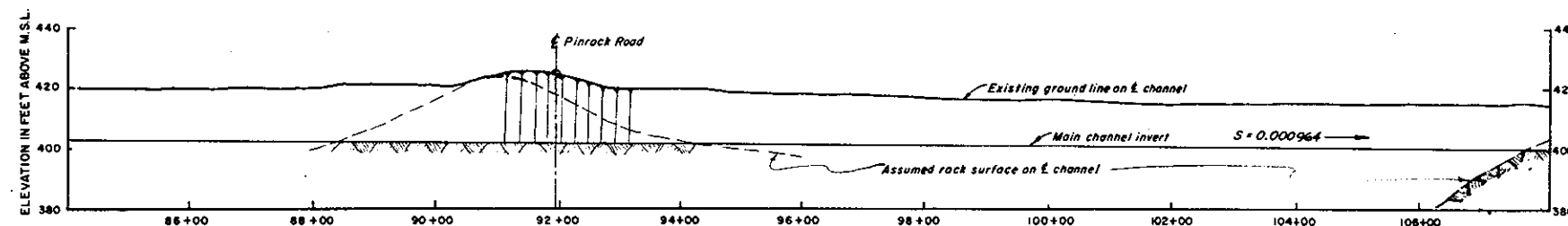






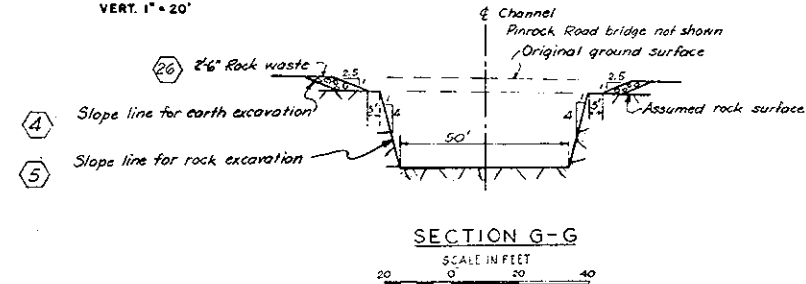
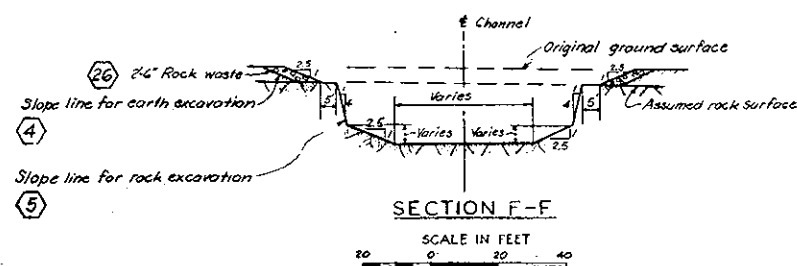
ELEVATION  
PINROCK ROAD VICINITY

SCALE IN FEET  
0 20 40



PROFILE

SCALES: HOR. 1" = 100'  
VERT. 1" = 20'



NOTES:  
All elevations refer to Mean Sea Level Datum.  
Contour interval 5 feet.  
For typical channel sections see Sheet No. 17.  
Final grading of channel slopes in vicinity of Pinrock Road to be determined in field upon completion of new bridge.  
For details of Pinrock Road temporary detour see Sheet No. 28.  
Figures in hexagons indicate items under which payment will be made.

Record Drawing  
Contract No. CW-19-018-57-428

REVISION	DATE	DESCRIPTION	BY

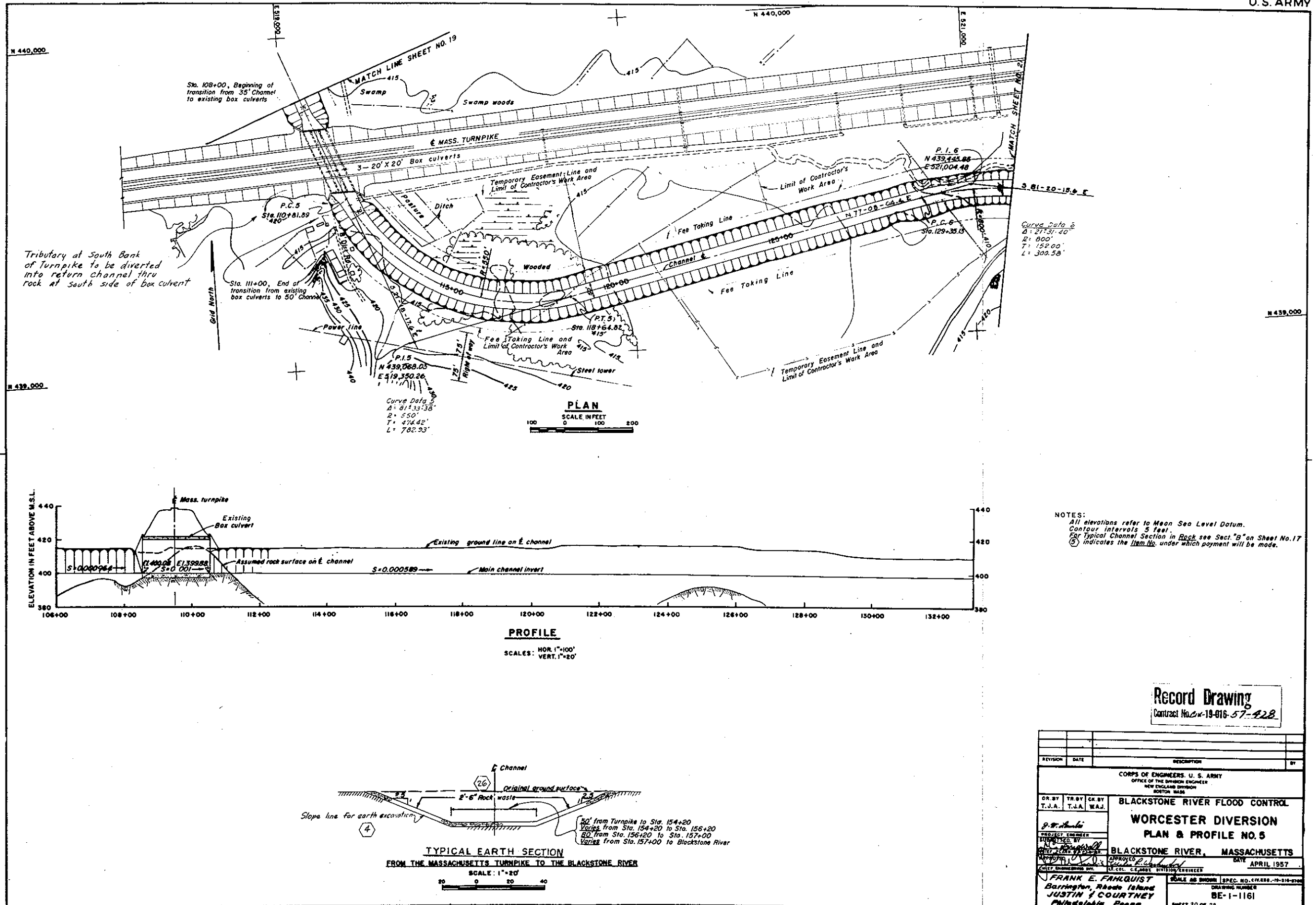
CORPS OF ENGINEERS, U. S. ARMY  
OFFICE OF THE DIVISION ENGINEER  
NEW ENGLAND DIVISION  
BOSTON, MASS.

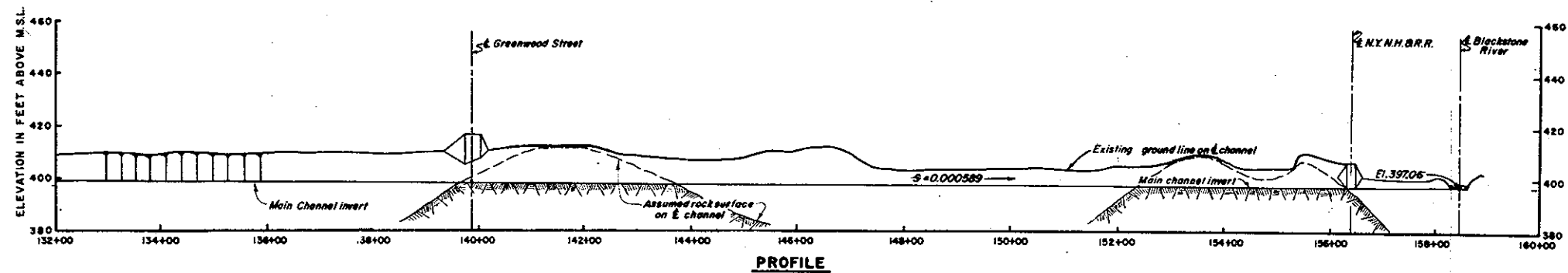
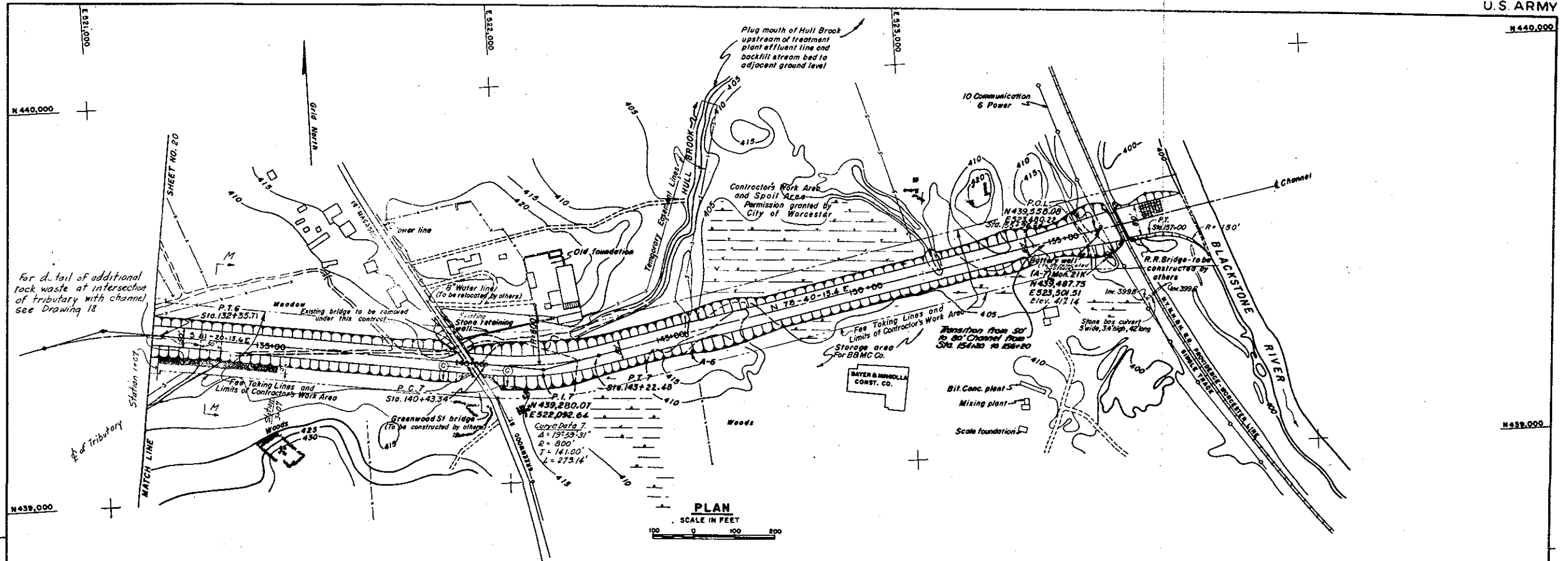
BLACKSTONE RIVER FLOOD CONTROL  
WORCESTER DIVERSION  
PLAN & PROFILE NO. 4

BLACKSTONE RIVER, MASSACHUSETTS  
DATE: APRIL 1957

FRANK E. FAHLQUIST  
Barrington, Rhode Island  
JUSTIN & COURTNEY  
Philadelphia, Penna.

SCALE AS SHOWN SPEC. NO. 19-018-01-02-03  
DRAWING NUMBER  
BE-1-1160  
SHEET 19 OF 20





NOTES:

All elevations refer to Mean Sea Level Datum.

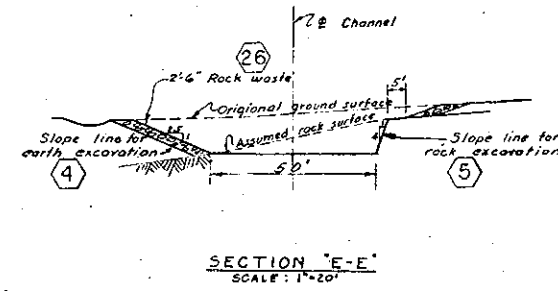
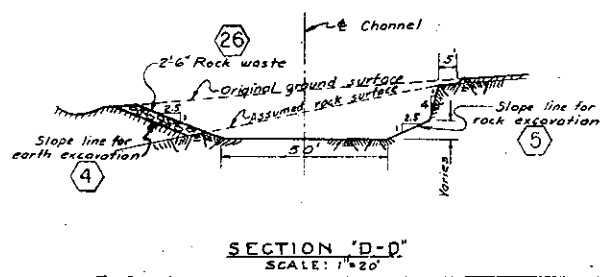
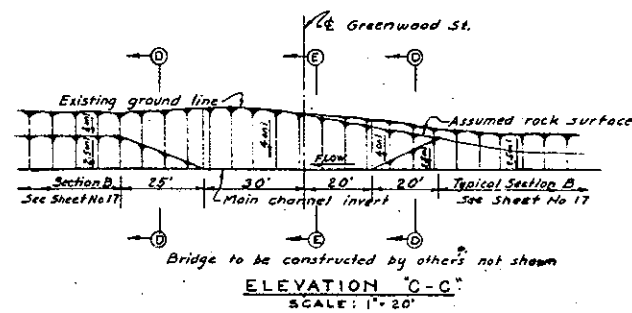
Contour intervals 5 feet.

For Typical Channel Section in Earth see Sheet No. 20.

For Typical Channel Section in Rock see Sect. 19' on Sheet No. 17.

(S) indicates the [S] No. under which payment will be made.

Final grading of channel slopes in immediate vicinity of Greenwood Street and the railroad to be determined in the field upon completion of the new bridges.

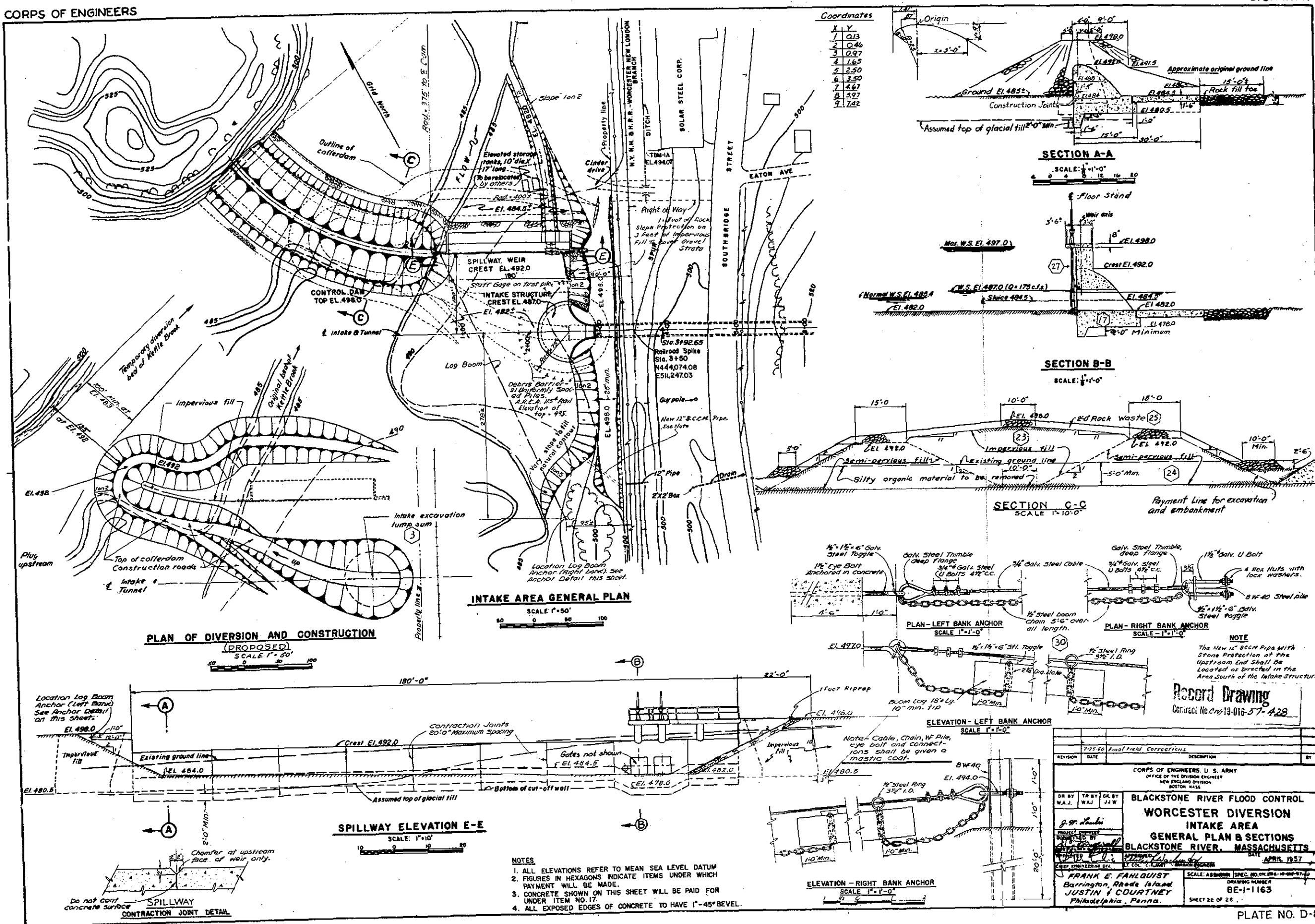


Record Drawing

Contract No. 19-016-57-229

CORPS OF ENGINEERS, U. S. ARMY			
OFFICE OF THE DIVISION ENGINEER			
NEW ENGLAND DIVISION			
SECTION NAME			
DR. BY	TEST	CH. BY	
W.A.J.	W.A.J.	P.G.	
BLACKSTONE RIVER FLOOD CONTROL			
WORCESTER DIVERSION			
PLAN & PROFILE NO. 6			
BLACKSTONE RIVER, MASSACHUSETTS			
DATE APRIL 1957			
FRANK E. FAHLQUIST			
Barrington, Rhode Island			
JUSTIN J. COURTNEY			
Philadelphia, Penna.			
SCALES: AS SHOWN SPEC. NO. CIV. ENG. 19-48-270			
DRAWING NUMBER			
BE-1-1162			
SHEET 31 OF 25			

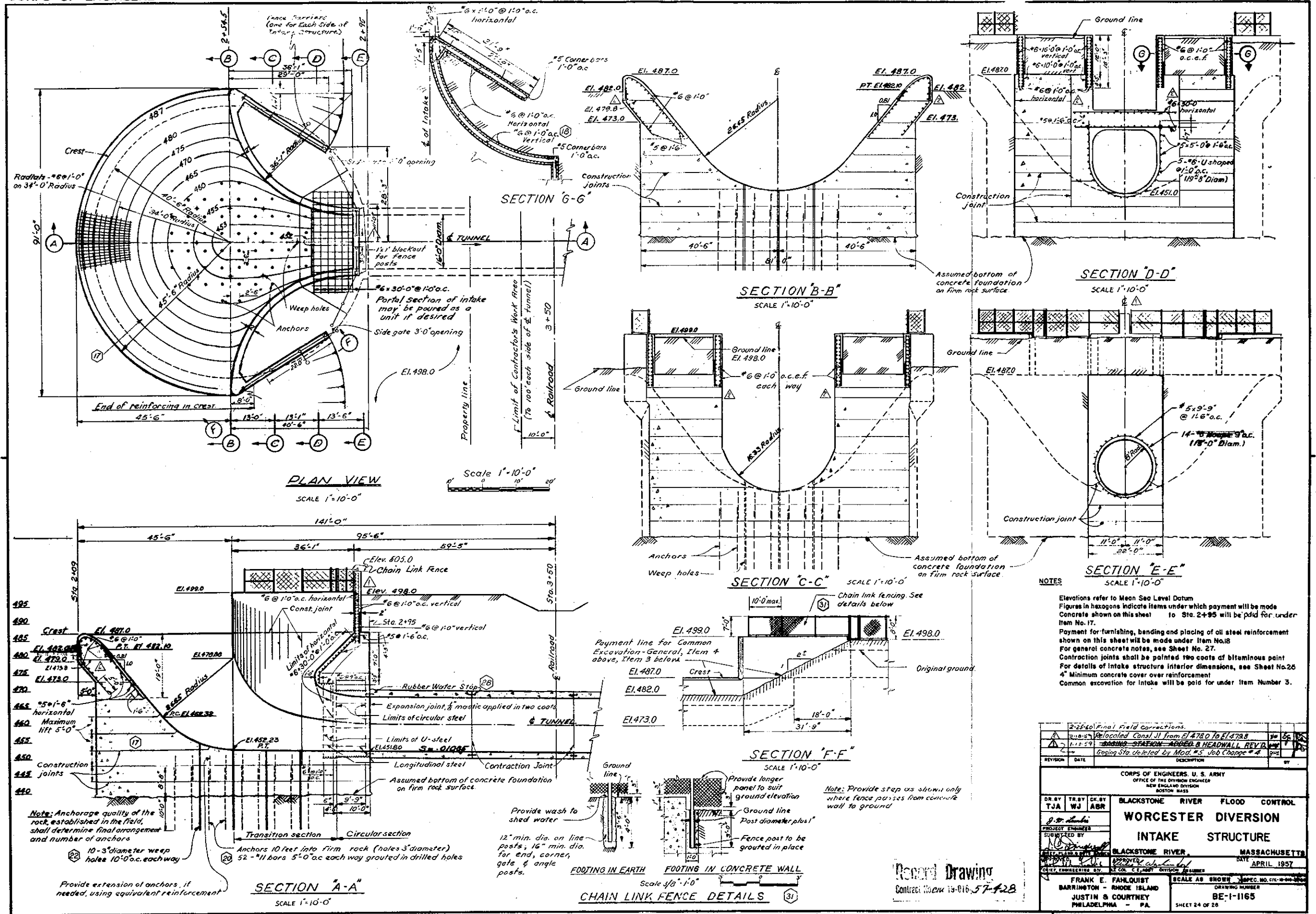
CORPS OF ENGINEERS

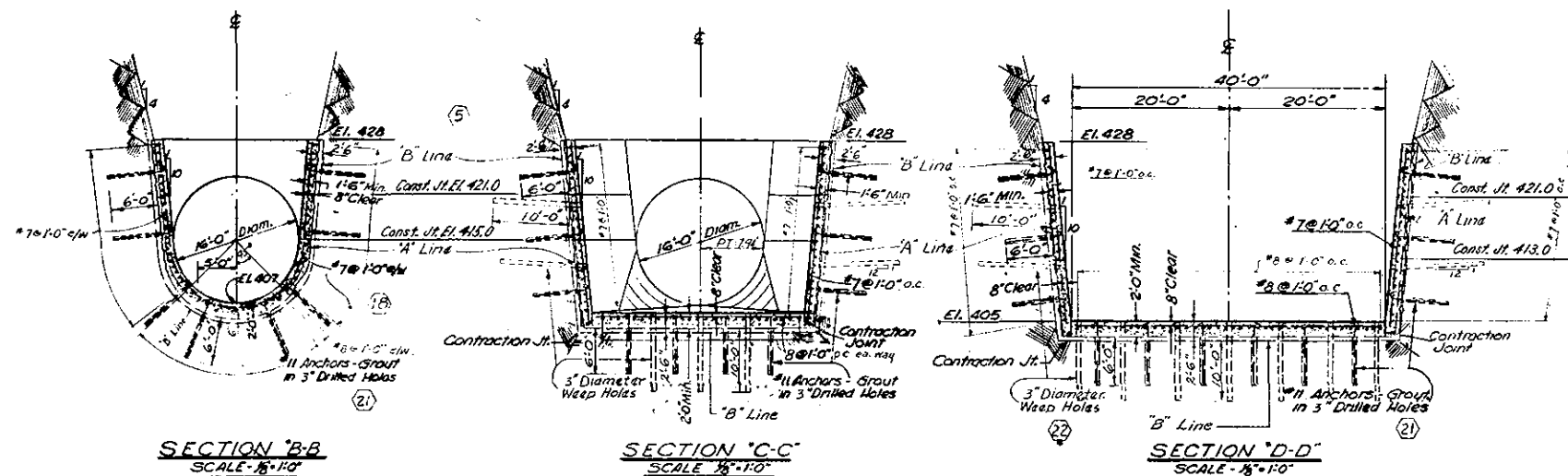
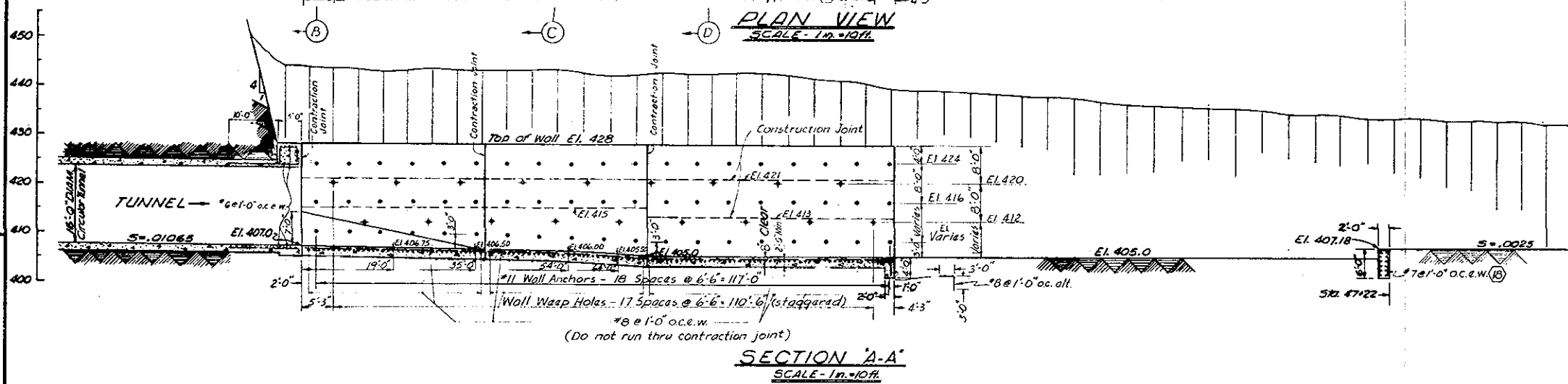
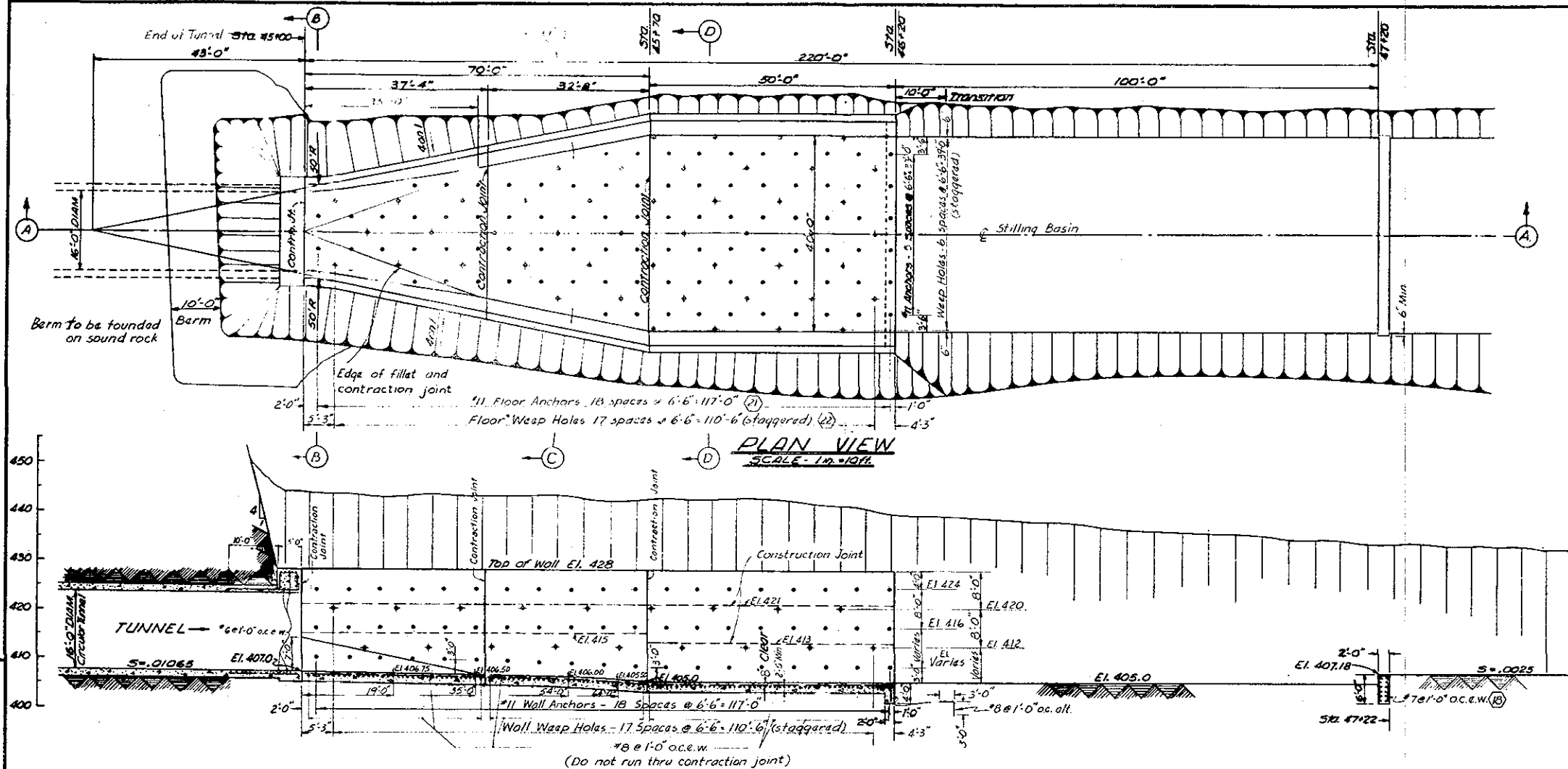












## NOTES:

- Elevations refer to Mean Sea Level Datum.
- Figures in hexagons indicate item numbers under which payment will be made.
- All concrete shown on this sheet between Sta. 45+00 & Sta. 47+22 will be paid for under Item Number 17.
- Payment for furnishing, bending and placing all steel reinforcement shown on this sheet will be made under Item Number 18.
- Payment for furnishing, bending and placing all anchors shown on this sheet will be made under Item Number 21.
- For general concrete notes, see Sheet Number 21.
- Contraction joints shall be painted two coats of bituminous paint.
- For treatment of slopes above stilling basin, see Typical Section "A" shown on Sheet Number 17.
- Payment for drilling weep holes will be made under Item Number 22.

REVISION	DATE	DESCRIPTION	BY

CORPS OF ENGINEERS, U. S. ARMY  
OFFICE OF THE DIVISION ENGINEER  
NEW ENGLAND DIVISION  
BOSTON, MASS.

**BLACKSTONE RIVER FLOOD CONTROL**

**WORCESTER DIVERSION**

**STILLING BASIN**

**BLACKSTONE RIVER, MASSACHUSETTS**

DATE: APRIL 1957

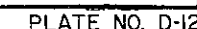
SCALE AS SHOWN (SPEC. NO. 200-10-01-01-01)

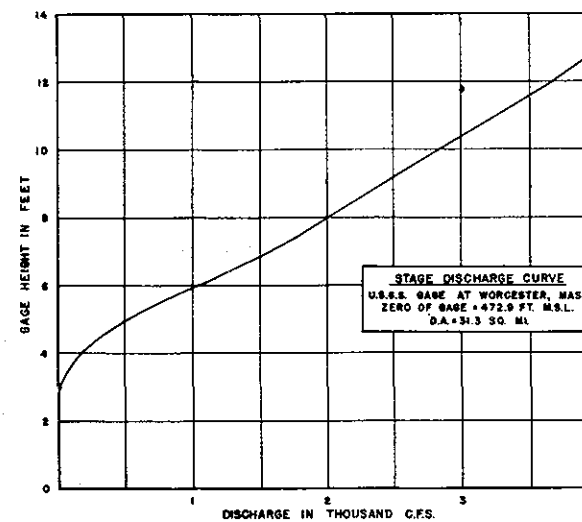
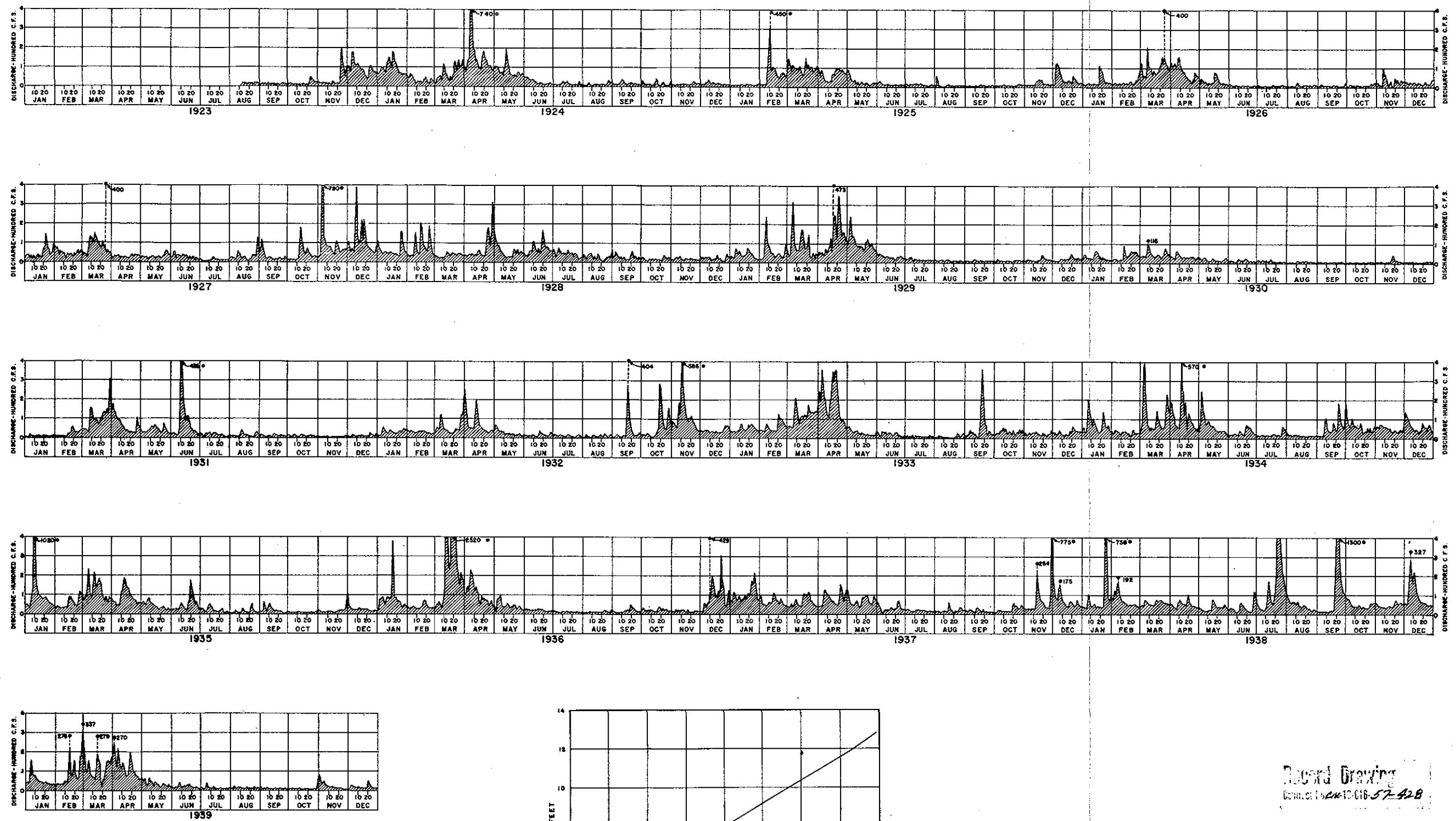
DRAWING NUMBER: BE-1-1167

SHEET 25 OF 28

FRANK E. FAHLQUIST  
Barrington Rhode Island

JUSTIN I. COURTNEY  
Philadelphia Penn.



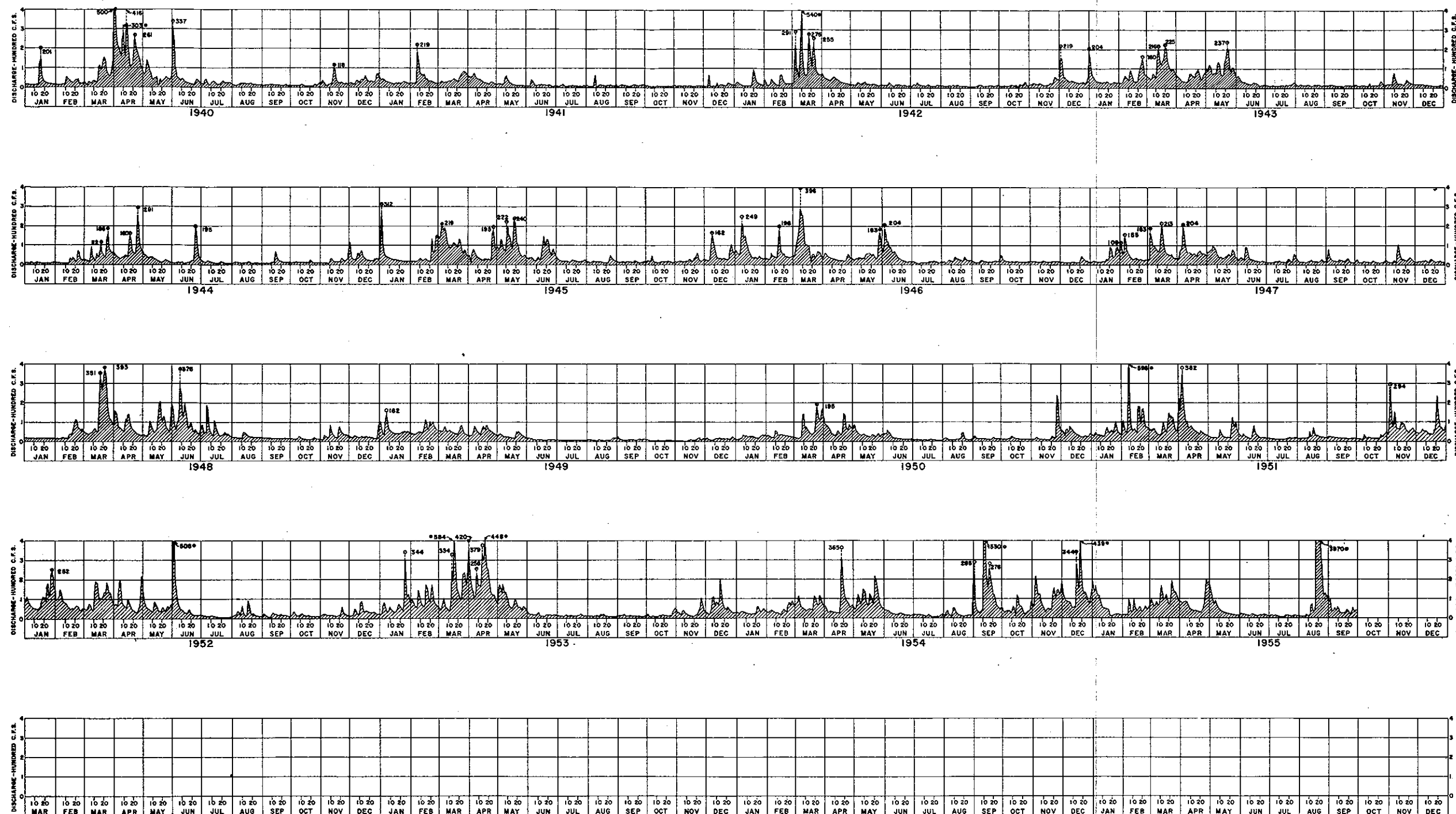


## NOTES

These hydrographs are the average daily stream flow record of Kettle Brook at the Worcester U.S.G.S. gage near Leesville Dam from the tributary drainage area of 31.3 Sq.Mi. Tributary drainage area above Worcester Diversion Control Dam is 30.1 Sq. Mi.

Instantaneous peak discharges, where available, are shown by \*.

REVISION		DATE	DESCRIPTION	BY
CORPS OF ENGINEERS, U. S. ARMY OFFICE OF THE DIVISION ENGINEER NEW ENGLAND DIVISION BOSTON, MASS.				
BLACKSTONE RIVER FLOOD CONTROL WORCESTER DIVERSION HYDROGRAPHS NO. 1				
BLACKSTONE RIVER, MASSACHUSETTS				
DATE AUG 1936				
SCALE AS SHOWN SPEC NO. 10-10-10-10-10-10				
DRAWING NUMBER BE-3-100				
SHEET 2 OF 28				



## NOTES

These hydrographs are the average daily stream flow record of Kettle Brook at the Worcester U.S.G.S. gage near Leesville Dam from the tributary drainage area of 31.3 Sq.Mi. Tributary drainage area above Worcester Diversion Control Dam is 30.1 Sq. Mi.

Instantaneous peak discharges, where available, are shown by \*.

10-11-55  
Checked by 57-428

REVISION	DATE	DESCRIPTION	BY

CORPS OF ENGINEERS, U. S. ARMY	
OFFICE OF THE DIVISION ENGINEER	
NEW ENGLAND DIVISION	
BOSTON, MASS.	
BLACKSTONE RIVER FLOOD CONTROL	
WORCESTER DIVERSION	
HYDROGRAPHS NO. 2	
BLACKSTONE RIVER, MASSACHUSETTS	
DES. BY A. R. K.	DATE AUG 1956
DR. BY J. D.	
PROJECT ENGINEER P. J. C.	
CHIEF, HYD. & HYD. SECTION P. J. C.	
SUBMITTED BY P. J. C.	
APPROVED BY P. J. C.	
CHIEF, ENGINEERING DIV. P. J. C.	
SCALE AS SHOWN SPEC. NO. CIV-ENG-106-57-90	
DRAWING NUMBER BE-3-1020	
SHEET 3 OF 28	